The Machining of Single-Throw Crankshafts.

The works of the Tindel-Morris Company, at Eddystone, Pa., are devoted mainly to the special purpose of machining crankshafts. For the performance of that work they have designed a line of highly interesting and remarkably effective special tools.

In roughing single-throw crankshafts the sequence of operations is: 1. Face up the outer surfaces of the crankshafts. 2. Turn the shaft. 3. Slot the crank. 4. Turn the pin. High-speed steel is used in all the work and the effectiveness of this is indicated by the piles of chips seen in some of the illustrations and which, we may remark, are conveniently gotten rid of by the use of manure forks.

Fig. 2. The machine will be seen to be extremely rugged and the cutters are of high-speed steel. The feeds are correspondingly coarse, about the finest used being ⅜ inch per minute, the range extending from this up to about ¾ inch.

The second operation—the rough turning of the shaft—is done on special lathes, of which we show one of several sizes in Figs. 3 and 4. Both headstock and tailstock carry centers only, the driving being done by the central ring driving head. Fig. 3 shows the rear of a large lathe, and from it the method of driving the ring head from a shaft and pinion in the rear of the machine is apparent, as is also the fact that the lathe has two tool carriages, both of which are made to feed from the

carrying the driving effort through the cranks, it permits much heavier cuts to be taken and insures truer work. The lathe shown will be seen to be of the most rugged character, and its execution is shown by the accumulated chips. The method of mounting the carriages on the shears in order to avoid interference with headstock and tailstock, and at the same time secure broad bases for the latter, will be noted.

The third operation of slotting the crank is shown in Fig. 5. The crank, having been drilled in the usual way to define the end of the piece to be removed, is mounted in a powerful double cold-saw and the two slots are sawed simultaneously. The thickness of the piece to be removed is

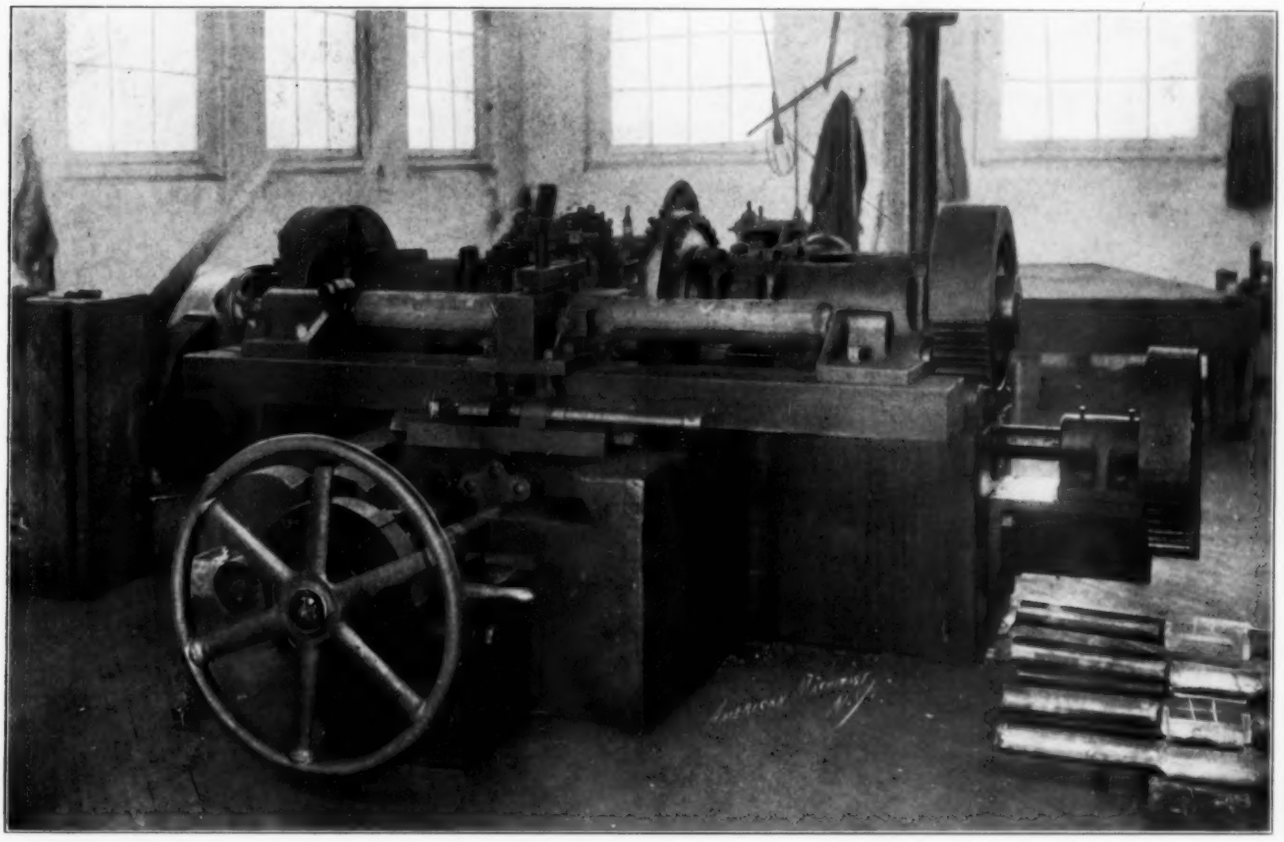


FIG. 1. DOUBLE HEAD CRANK MILLING MACHINE. FRONT VIEW.

The forgings are first measured up and laid out on a laying-out table, shown in the middle background of Fig. 2, and, after centering in the machine shown in the rear and at the right of the same illustration, are taken to the special double-head milling machine shown in Figs. 1 and 2. Of these the former shows the manner of locating the work in the machine by the centers, while the clamping is done by conveniently located clamp screws acting on the crank portion of the forging. Inasmuch as the amount of material to be removed at this operation varies widely with different forgings which are nominally alike, the inserted teeth of the milling heads are disposed in sets of three arranged to act in succession, as shown in

crank toward the ends. Fig. 4 shows a front view of the same lathe. The steadying chuck-jaws are of the floating type and, as the closing screw is tightened, they adjust themselves to the inequalities of the forging without springing it and, after grasping the crank portion, they are bound in position by clamping bolts which prevent deflection under the pressure of the cut. A second set of bolts above the chuck-jaws is then adjusted to contact in order to assist in the driving. This principle of driving by the crank is a special feature of the Tindel-Morris lathes, and obviously permits the turning of both ends complete without interference from the usual dog. Quite as important also, by avoiding the springing of the shaft due to

determined by suitable spacing collars between the saws. The feed of this machine is about the same as that of the double-head milling machine. It depends, of course, on the thickness of the work, but ⅝ inch per minute is not uncommon. The pattern of saw shown is a development to meet the needs of the work, and is shown more fully in Fig. 6. The saw blade is a substantial disk of high carbon crucible steel, the teeth of self-hardening steel being inserted in the sides and staggered. The making of the slots is a straight milling machine operation, the slots being undercut and inclined laterally to give suitable clearance to the sides of the teeth, and inclined to the radius to give a suitable top rake to the teeth. The teeth are of the

simplest possible shape, being nearly rectangular but flaring slightly to suit the undercut of the slots. This form is given them by slight forging in a die, the final size being given by grinding. The teeth have no keeper of any kind, but are simply driven into their slots, where they remain until worn out or accidentally broken. The semi-circular ends of the slots make it easy to drive out a tooth on occasion by the use of a suitable drift.

The final operation of turning the crankpin is done in another special lathe shown in Fig. 7. This machine has an immense hollow spindle with a hole large enough to provide for the throw of the crank. Special bushes fitting the turret shaft are placed in the spindle and adjusted laterally for the throw, and serve also to insure the parallelism of the pin and shaft. The clamping of the crankshaft is by a floating chuck similar in principle to the one used on the shaft turning lathe and, as in that lathe, the gripping of the piece is at the nearest possible point to the cut being taken.

The turning of a crankshaft by the usual methods is well known to be one of the most tedious and unsatisfactory of shop operations. Our readers will not need to be informed that the execution of these machines is far in excess of what is ordinarily possible. We have described the operations as roughing operations only, rough-turned shafts being the principal product of the Tindel-Morris Company, but the same machines and methods are obviously equally applicable to finishing operations and are so used on occasion. The roughing of all parts is of course completed before the finishing of any is begun.

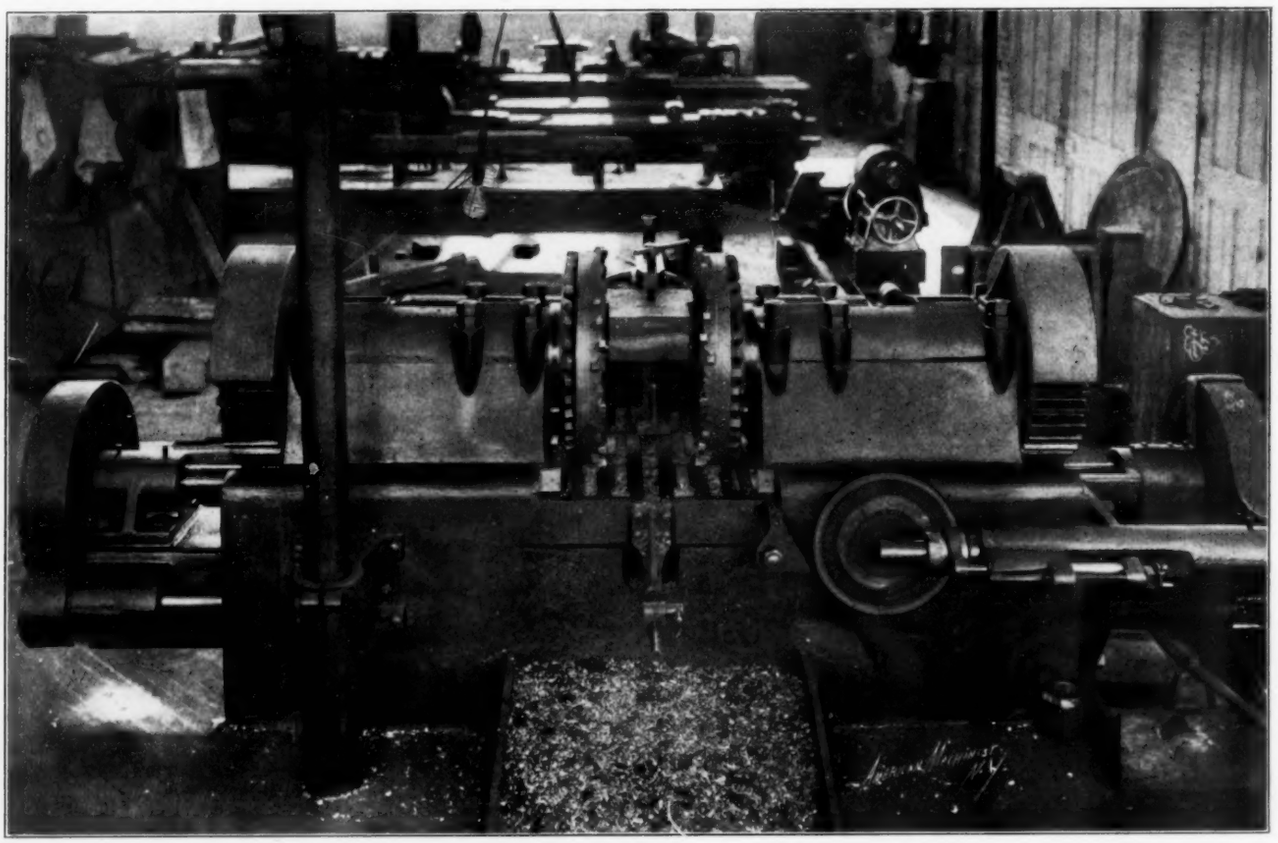


FIG. 2. DOUBLE HEAD CRANK MILLING MACHINE. REAR VIEW.

The Value to Inventors of Being Able to Draw.

BY PROF. AMASA TROWBRIDGE.

To all of us who are consulted by inventors, either for opinions as to the value of their inventions or for assistance in perfecting the inventions, it is apparent that an enormous amount of time is wasted by the lack of a knowledge of drawing. An exact drawing, even on a small scale, is usually all that is required to show the usefulness, or otherwise, of a new scheme. Of course a working model is required to prove the value of the invention to a man who cannot read drawings, but such a model can be very readily constructed, if the exact drawing has already been made.

It is quite possible to find some scheme for generating or for using power, or some process for manufacturing, which is not in use but which seems practical and efficient. To actually attain practical results, however, it is often necessary to spend a great deal of time and money making experiments, and it is only possible, ordinarily, to make these experiments on a very small scale. In the case of almost any kind of machinery, a drawing can be made that will show conclusively whether the scheme is possible or not, and one can even go farther and decide the limit of the amount of work the machine will produce, in many cases.

In quite a number of cases I have known inventors to build a model which was literally "cut out of whole cloth," as it was made by starting with one part and fitting each successive part to the rest of the machine as it progressed, with no plan but that in the head of the inventor. This usually results in a number of models being built, or the model will be so unsightly as to call forth only ridicule. A drawing, however, can be changed as much as one wishes, without injuring it at all, and as many models as are wanted can be built on paper, with no appreciable cost except the time spent in drawing them. In one case I happen to remember, a firm had five different designs made of a very complicated machine before a single model was built. All five designs did not cost as much as one model, and the design that was finally used was very satisfactory.

Probably the most perplexing part in the designing of machinery is to design cam motions and to time them to work with the other parts of the machine. This is not really a difficult matter and, with a little practice, one can easily lay out a cam for any given motion and so time it that it will work in perfect harmony with the rest of the machine. A machinist who made a specialty of building models once told me that he always made his cams by fitting them on the machine so as to be sure that they would work. His method was to

FIG. 3. CRANK SHAFT TURNING LATHE. REAR VIEW.

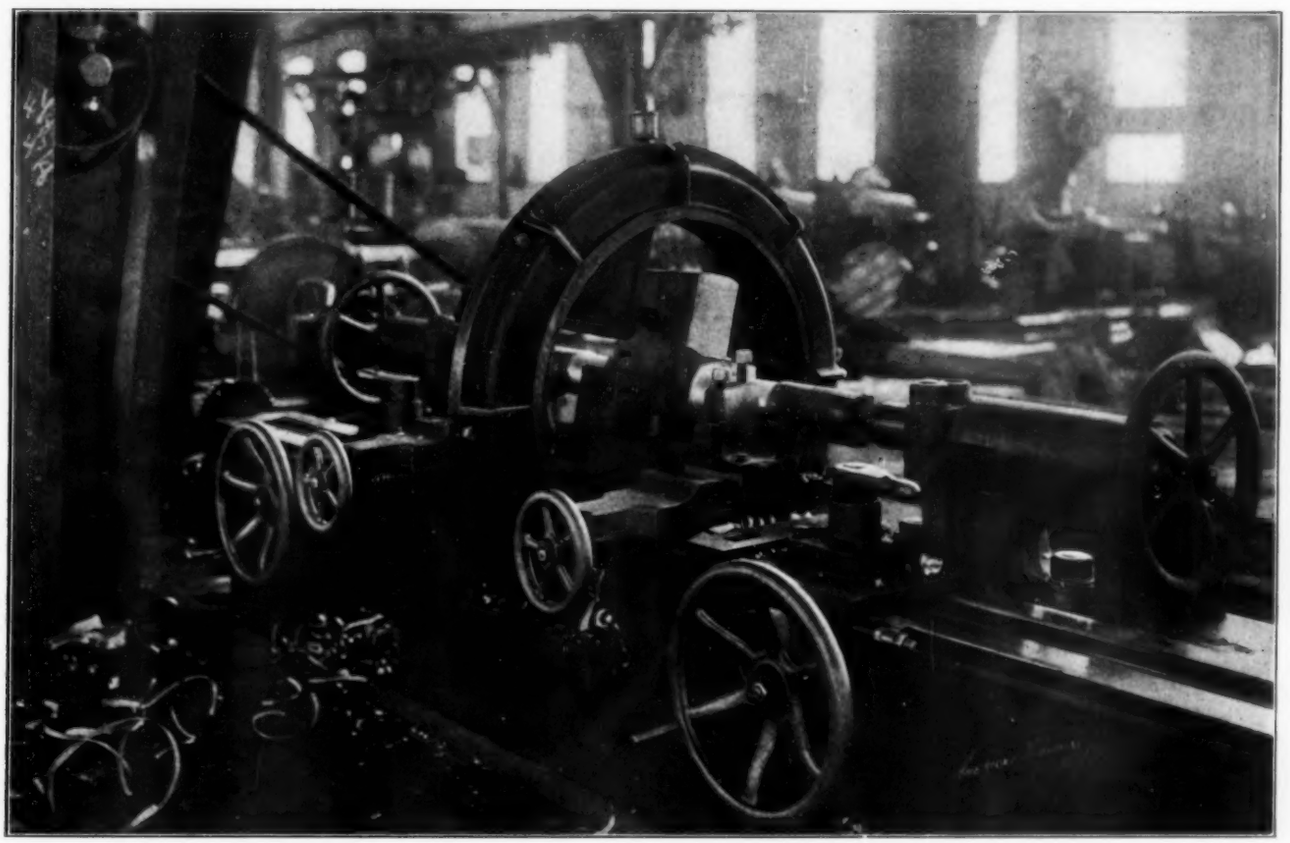


FIG. 4. CRANK SHAFT TURNING LATHE. FRONT VIEW.

take a blank and mark it as closely as he could when it was in position, and then cut it out and try it. Then he would note where it was wrong, take it off and cut it more or build up any places that were too low. In this way he eventually found a form that would work and used that as a model for making the cam to be used on the machine. It sometimes happened that he would make one cam in this very tedious manner and then find that he must throw it away because some other cam could not be made to properly "time" with it. All this bother and expense can be saved by having first schemed out all the necessary motions on paper and so arranged them that they will time properly.

make a clear, accurate drawing, he would save himself a great deal of time and money, and would be able to see, in almost every case, just how valuable his invention was, which might keep him from spending more time trying to find someone to pay for useless experiments.

It is not a difficult matter nowadays for anyone to learn drawing, even though he must earn his living. All the mathematics needed are just arithmetic and geometry, and, if no evening school is handy, some correspondence school course can always be obtained, and there is consequently no excuse for the inaccurate, distorted sketches so often presented to experts for opinions, or to likely investors to draw

ments it is only necessary to point to the record of John Ericsson, who stands at the very top of the list of naval inventors, and who designed and made the working drawings for the "Monitor" from stem to stern. To answer the second statement it is only necessary to refer to Thomas A. Edison, whose inventions have almost entirely been brought to a practical working order by his own brain and hand. Working out the details of an invention does not interfere with making other inventions but is, on the contrary, often the direct cause of new discoveries. Inventions discovered in this way have sometimes proved to be even more valuable than the original invention.

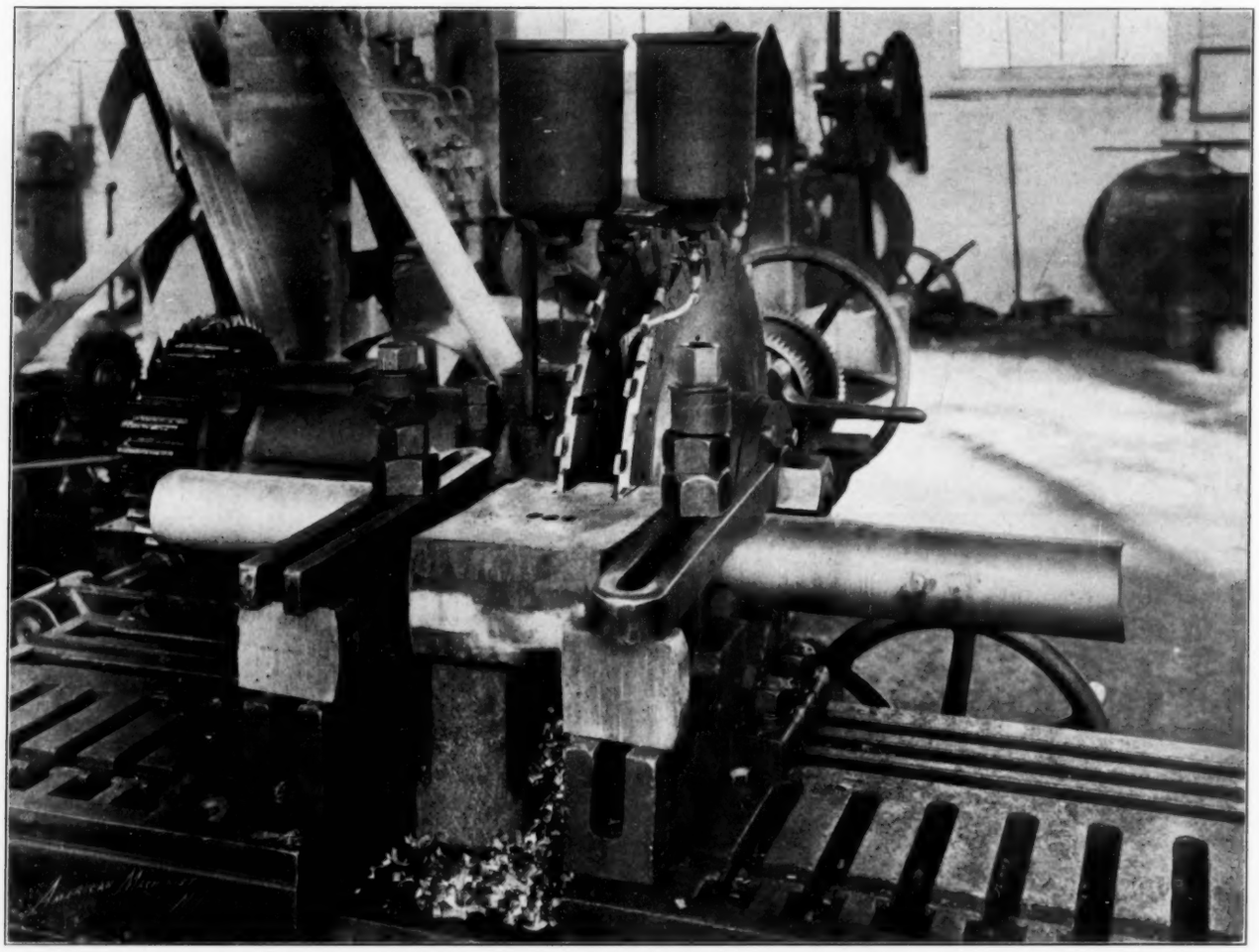


FIG. 5. COLD SAW SLOTTING MACHINE WITH TWO TINDEL COLD SAWS.

To illustrate the possibility of this, I will cite this example: I once designed a machine in which I used a method of transferring the work from one die to another which I had never seen before or heard described, though it may have been frequently used, and where four cams had to work exactly at just the right time. This machine was built exactly according to the drawings, keyways being cut in both shaft and cams, which latter were fully dimensioned on the drawings, and when so built it turned out forty-eight perfect pieces per minute.

If every inventor would learn how to

forth capital. Such sketches might as effectually conceal a valuable idea as they could distort a worthless idea and make it appear valuable. Unless an artist has a knowledge of drawing his grandest conceptions would be lost, no matter how beautifully they were colored.

Inventors sometimes claim that to try to draw out their inventions and proportion the parts properly, ties them down so closely that it interferes with a free flow of ideas. They also claim that it is not the province of the inventor to reduce the invention to practical proportions.

To answer the former of these state-

Another way in which a knowledge of drawing is extremely valuable to the inventor is in the protection it gives him, from any who might seek to defraud him. If he has a good, clear drawing of his invention that has been dated and signed by witnesses, he is not nearly so dependent on the honesty of his patent lawyer. Inventors often find themselves robbed of their inventions and utterly unable to prove that the invention was theirs at all. An inventor who has only a rough sketch of his invention is completely at the mercy of the one to whom he goes to have it worked up and put in shape for patenting,

and about the only way in which he can protect himself at all is to have a good, clear drawing by which he can prove ownership and which he need not put in the patent lawyer's hands at all. This could be a tracing or a blueprint, which should be sealed and dated, and deposited on the given date, where it would be safe and could be produced as evidence at any time. Inventors who are not thorough engineers often have to get assistance from an engineer to perfect their inventions and make them practical. Here is a very common cause of trouble. The engineer so employed expects pay for any actual inventions he may make in the course of his work and usually claims such pay. It may happen that some things which the engineer thinks out by himself were embodied in the original invention, but not clearly shown, if they were shown at all. When it is time to arrange a settlement, a difference of opinion as to who made the invention naturally arises, and it is usually the inventor who must lose, as he has no proof of his ownership and the engineer can show, by his drawings, the development of the invention and just where he applied each new idea.

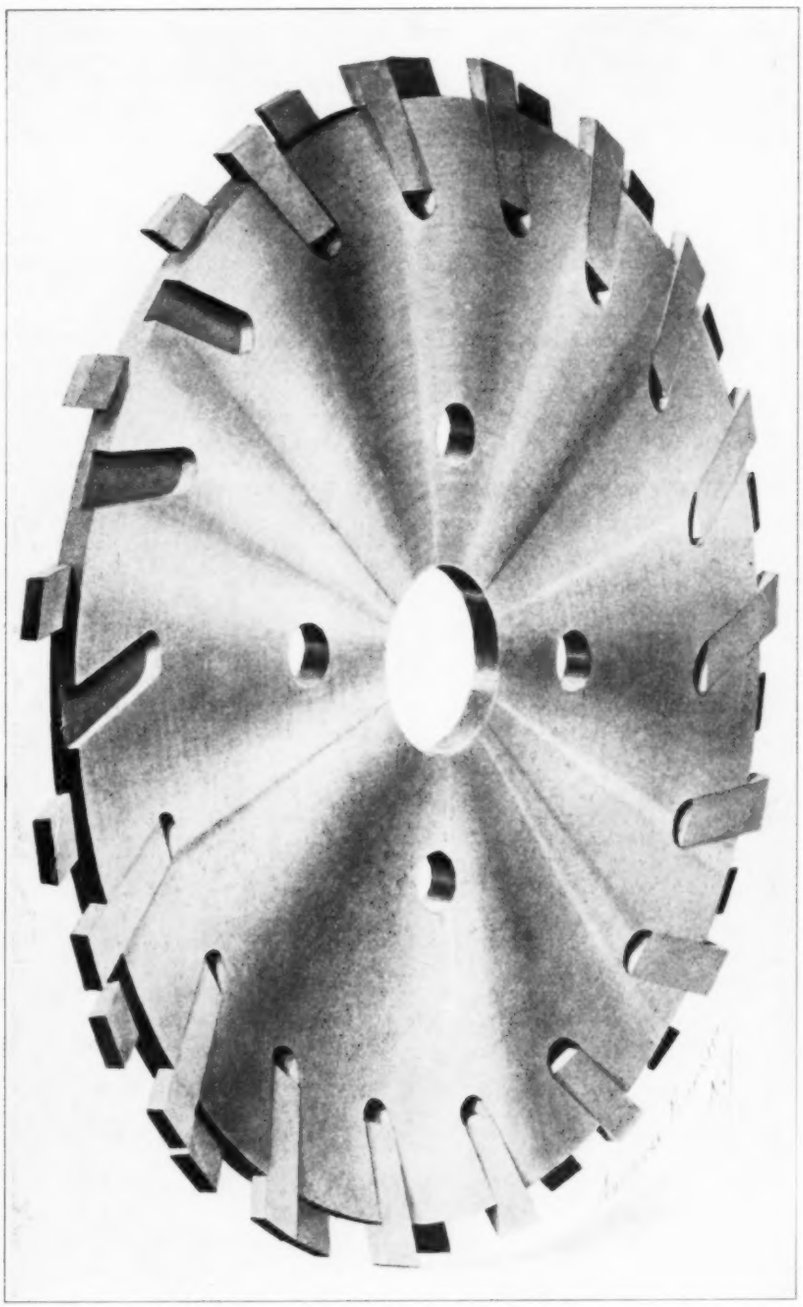


FIG. 6. THE TINDEL COLD SAW.

Almost all his troubles and a good deal of expense can be saved by the inventor if he will only learn to make a good, clear drawing showing things in fair proportions, though the invention need not necessarily be perfected enough for manufacture. He would also find it far easier to obtain capital for manufacturing purposes with the aid of such a drawing, though the working model, made from his drawing, is by far the best thing for this purpose.

Bolt Heading Dies.

BY THOMAS BEASLEY.

Wherever wrought iron, mild steel or tool steel is used in quantities as special or standard forgings, there the designer and fitter of forge dies and formers finds employment, and usually at increased wages over those of the ordinary machinist.

It sometimes happens that the simplest looking piece is really the hardest to get a perfect working former for, as I have sometimes found to my vexation. Bolt-heading dies are perhaps the simplest and best understood, but, as with everything else, there are certain things which, if overlooked in preparing them in the machine shop, often hinder their proper working. The common mistake with these dies is in planing the dies separately. They should be clamped in the planer or shaper and planed in pairs and the halves numbered. With the two dies planed at the one time, even if the dies do come out of the chuck a little out of square, both dies will be nearer alike and fit better than if machined separately. What has to be looked out for in either case, however, is that the end be square with the sides. The two dies, if planed together, do not have to be perfectly true on the sides or bearing surfaces. They will come together as they should, but of course the ends should meet square or shimming will be required, and this should be avoided as much as possible.

When the dies have been planed on their four outside surfaces the working surfaces are ready for attention. The pieces should be clamped in end to end, so that the cut is taken lengthwise, and after the surfaces are finished and before removal from the chuck a V-channel should be cut for a guide for the center of the drill in the middle of the two faces. After the dies are taken from the chuck, if the ends do not come square and even, make them so, and they are then ready to be clamped together and drilled. The clamps should have two holes drilled for compression bolts just far enough apart to give $\frac{1}{8}$ inch clearance for the dies to enter easily. The dies should be mated on a surface plate and the two ends that match the best brought together. A 1-32 inch piece of sheet iron should be placed between the dies. This makes the hole slightly oblong and compresses the iron when the dies come together when heading the bolt. Otherwise the iron would slip through the dies when in operation. The drills should be the same size as the iron; but for neat, accurate work, a reamer should be used for finishing, as a twist drill sometimes makes a very rough hole. When reamed to the proper size, and before removing from the clamps, the piece should be marked one and two on one end and three

and four on the other end for the guidance of the machine operator. To keep the dies steady when drilling, a cross clamp also should be provided to bolt the dies to the drill table. If left free to move with the drill the hole is apt to run crooked. The dies are then ready to have

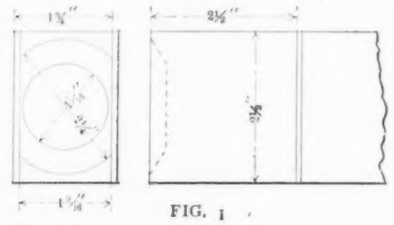


FIG. 1

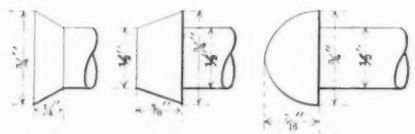


FIG. 2 FIG. 3 FIG. 4

American Machinist

BOLT HEADING DIES.

all the sharp edges removed with a coarse file. The quality of the work and also the amount produced depends a great deal on how the dies are finished. If they pinch the iron on the corners of the dies more than at the middle of each semicircle they will not do one-third of the work. To get this bearing the corners should be filed rounding. The sharp wire edges should be removed also from the ends and made slightly countersunk The dies should be made of tool steel, and in hardening heat to a low cherry red and cool in oil. The temper need not be drawn.

The heading blocks are the next to receive attention. After all the surfaces are planed true, and to size as near that of the gripping dies as possible, they are ready to be hardened. They should be heated to a good cherry red and dipped in water and not drawn, as they should have very hard working surfaces.

The headers give more trouble than either the dies or the blocks, for they are hard to hold in the lathe and the working surface on them has to be finished, as any rough surfaces make a bad job on the head of the bolt and the working life of the header is cut down.

The header generally used is 1¾x2x12 inches. The rule for the heading end of these headers is, one and one-half times the diameter, with 1-16 inch added for the thickness, and of course 2½ inches wide or wider if wanted. For illustration we will take a 1-inch bolt; this would give a header as per sketch, Fig. 1, both ends alike. The rule for recessing the ends is: ⅛ inch less than the width of the header for the inside circle, ¼ inch more than the distance across the corners for the outside circle, and one-quarter the diameter of the iron for depth of recess. For 1-inch bolts the dimensions of the header would be: 1 7-16 inches for inside circle, 2¼ inches for outside circle, and ¼ inch for depth.

For finishing the recess a couple of flat files shaped on the end to the profile of the recess and used to scrape the rough surface after turning will be found very handy; they should be ground true to size and made very hard. They can be made to clamp in the tool-post, but they are more handy and quicker used as hand tools. After the headers are scraped out clean, finish them with a piece of fine emery cloth so that the surface shows no tool marks of any kind. They are then ready to have the wire edges filed off and especially across the center, as the inside circle does not quite take out all the stock from the sides. File this surplus off even with the base of the circle and polish smooth. It is then ready to harden and should be given an oil dip at a low heat. Let me impress on you now that the rougher and harder the headers are made the less work they will do and the more they will crack in use, so don't let some "smart Aleck" bolt maker talk you into making them like flint.

Countersunk head bolts are practically the same as square head, except that the head is made in the gripping dies and no header blocks are required. The header is of the same dimensions as that previously described, with one end flat. The rule for countersunk heads is: Half the diameter of the iron for depth of head, and one and a half times for the large diameter of the head. Taking for example a ½-inch countersunk head bolt, the dimensions would be as per Fig. 2.

This same rule applies to button-head bolts. Cone-head bolts and rivets are made the reverse way from countersunk head bolts; that is, the head is formed in the header instead of in the blocks. The rule is: The diameter of the iron for the small circle, one and a half times this for the large circle, half the size of the iron with ⅛ inch added for the depth as per Fig. 3. Rivet dies for structural, boiler and car work need more care than any other class of dies, for the reason that mild steel is now used to a great extent in this class of work and the dies and headers have to stand greater strains. Both dies next the head should be slightly countersunk and rounded nicely with a fine file. Care should be taken to have plenty of stock on the sides of the headers as they are under

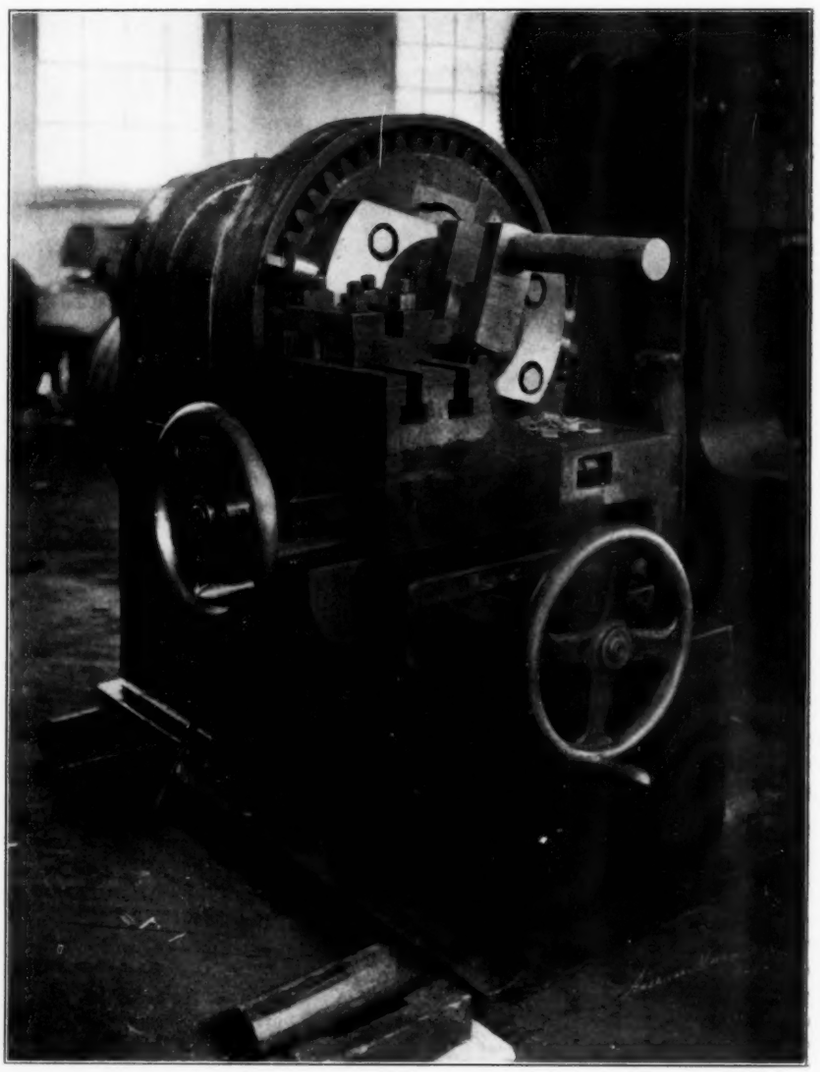


FIG. 7. SPECIAL CRANK PIN LATHE.

great stress in doing the work. If the header is not wide enough to have ¼ inch stock outside of the recess (⅜ inch would be better) have the header upset. The rivet produced is shown by Fig. 4. This gives practically the same rule for these heads as for the cone heads, except that the depth is 1-16 inch less than the diameter of the iron.

It is a very common mistake for a machinist to drill both ends of a pair of dies the same and make both ends of a header the same, but this should never be done unless you want four pairs of dies and four headers to use for the same size of bolts. Where both ends are made the same, they can't be repaired when worn out until both ends are gone, and that hangs them up and puts the machine out on that size until they can be fixed up; but if you have, say, ½ inch on one end and ⅝ inch on the other and two pairs of each, when a pair needs repairing you still have a pair in reserve, and the headers the same.

The Top of a Green Sand Mold.*

In considering the top or cope surface of a green sand mold we have to treat of means for suspending bodies of sand, the degree of dampness, the density of sands and the question of open or closed risers.

Conceding that it is an achievement to suspend a body of sand, the question is how to do it. Tests show that, on an average, a cubic foot of rammed sand weighs about 100 pounds, and that it can be suspended in bodies ranging from 14 to 18 inches square by 4 to 6 inches deep, the deeper the body the greater the area that can be carried. In some cases one could safely utilize bodies having an area of 14 to 18 inches square, while in others not much over one-half this area could be safely used. Where the areas of copes exceed 14 to 18 inches square they are subdivided by crossbars, which give us what may be called sub-pockets. These divisions vary in form, the one of greatest utility being oblong, as by this form larger areas can be suspended than by square ones. As an example, a space 6¾x48 inches can be rammed to far more firmly suspend a body of sand than one of the same area put in the form of 18x18 inches. This illustrates a principle in cross-barring copes, which, if kept in mind, would greatly decrease the number of "drop-outs" or the pushing of the sand up out of the bars when molds were poured.

UTILITY OF GAGGERS AND SOLDIERS.

To assist the cross-bars we have "soldiers" and "gaggers," with which all founders are familiar. Soldiers or gaggers should be used only where necessary to help in suspending bodies of sand, or in preventing the "drawing down" of cope surfaces, as their use is liable to cause uneven surfaces or blow holes.

The question could be asked: Which is best, soldiers or gaggers? This depends upon conditions: a soldier, if of the same length as a gagger, can suspend the greatest body of sand, for the reason that its sides offer greater surface for hanging sand to adhere to, and that between the bars to be packed against it.

The work most largely dispensing with the use of soldiers or gaggers is such as stove plate. Here the faces of the bars *A*

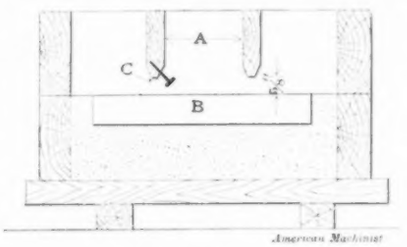


FIG. 1. USE OF CROSS-BARS FOR HOLDING COPE SAND.

are evenly chamfered, as in Fig. 1, and brought within ½ to ¾ inch of the face of the pattern *B*. In some cases where inferior sand is used the faces of the cross-bars may have nails driven into them every 2 to 3 inches apart on both sides, or one row in the center at *C*. Some shops other than those making stove plate, etc., adopt this nailing plan in some of their work in preference to using gaggers. The chief objection to this lies in the fact that the projecting nails are so hard on the fingers when "tucking the bars," and in the liability of molders to neglect the tucking on account of the nails.

In Fig. 2 are displayed a few good and bad practices in setting gaggers. At No. 1 is seen a gagger coming up but a short distance between the cross-bars, while at No. 2 it extends the full hight of the bar. A gagger or soldier in suspending bodies protruding below a joint should extend fully two-thirds its length up between the bars, as seen at No. 2. One would stand a better chance to lift a body as at *D* without using gaggers than to set them like No. 1, for the simple reason that the

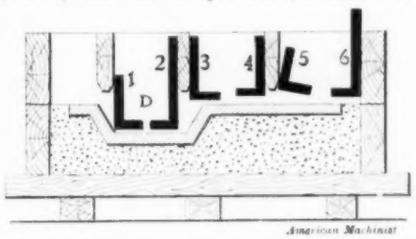


FIG. 2. CORRECT AND INCORRECT USE OF GAGGERS.

space occupied by the gagger is heavier than so much sand.

At Nos. 3 and 4 are seen practices followed in setting gaggers on sand sieved or placed over the face of a pattern, where one is nearer the pattern than the other. Where castings are heavy, and especially if there is any liability of the sand drawing down, it is generally advisable to have but about ¼ inch thickness of sand under the gaggers, while with light or thin castings ½ inch thickness is best, as by this a better chance is afforded for the escape of gases and the avoidance of hard spots. Many follow the careless practice of setting gaggers having a lot of flour paste or lumps of clay sticking to the toes of them when setting them on to the sand which covers the face of the pattern. Such cause mud spots which, in thin castings, can readily produce defects in their cope surfaces.

REGULATION AND EFFECT OF DAMPNESS IN SAND FOR RAMMING COPES.

Different treatment is required for ramming copes from that for forming the bottoms of molds. One peculiarity lies in the provision for the escape of steam, which can be illustrated by imagining the difference in pouring molten iron into a ladle having water on its bottom or in pouring water on the top of a ladle of metal. The latter is so harmless that I often, when in a hurry to cool off the metal in crane ladles to get the right temperature for casting, pour one or more pails of water on top of the metal. The only thing to guard against in doing this is not to press the chilled crust under the molten metal to melt it before all signs of dampness on the surface of the crust have disappeared.

It is not to be understood that we can in all cases have the top surfaces of molds excessively damp or approaching a mud. There are cases, however, when in copes we require the extremes of dry and wet more than in the formation of bottoms. These extremes are to be found in light and heavy work, and are due in the case of light work to the sudden contact of metal against a large surface, while in the case of heavy work it is due to the exposure of large suspended surfaces to high heat. To illustrate the first, we will take the case of large boiler fronts. In pouring such castings the metal must, as a rule, be rushed in with all speed practicable, and in castings over ¼ inch thick the metal flows over the bottom in a thin sheet until it is all covered; this done, it rises in a fairly uniform body until it strikes the cope surface and pops up the risers, indicating that the mold is filled. The filling of such molds and lighter ones is so sudden there is little time given for the escape of steam or gases, and hence the greater need of precautions for preventing their formation and for providing means for free liberation.

DRAWING DOWN OF AND SKIN DRYING COPES.

Having shown the necessity for using sand as dry as practicable, I will now show conditions wherein the reverse is advisable. These are found in the making of heavy castings having large cope areas which will be exposed to the direct heat of the metal during the time the mold is being filled. Take the case, for instance, of making a casting 4 to 6 inches thick by 5 or more feet square. Here, from the

*Abstract of a paper by Thos. D. West, presented at the Boston meeting of the New England Foundrymen's Association.

time we start pouring until the mold is filled, which can range from one to four minutes, the top of the mold is exposed to the intense heat of the rising metal, and should a mold be poured short and have to wait for iron, it might be so exposed for five to fifteen minutes. It will be evident that the heat from such a body must be very active in drying the

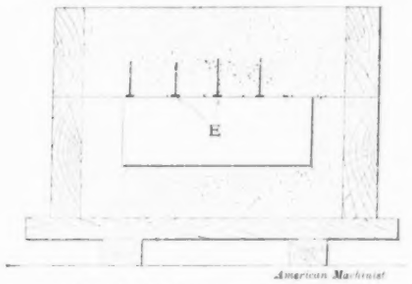


FIG. 3. NAILING COPE SAND.

surface sand exposed. This is found to be the case in making heavy castings. It has caused much bad work and originated the technical term "drawing down," which in a literal sense is the dropping down of sand that has been dried by the heat. Molders not having experience in making heavy castings have found the top surfaces of their castings with large flat lumps on them, and the sand which came from these places has floated off to form depressions or cavities in other portions of the top surface. The sand used for the first inch or so on the top face of the mold must be such that instead of the intense heat drying it to dust, it will bake it to form a hard crust, and then by being closely gagged or surface-nailed as at *E*, Fig. 3, it will not separate from the damp sand above. Some sand is suitable without mixture with any material for this work, while sometimes flour or clay wash is mixed with sand to produce a facing that will bake when heated. As a rule, all such facing sand must be made much damper than that used for light castings, and, aside from starting with a much

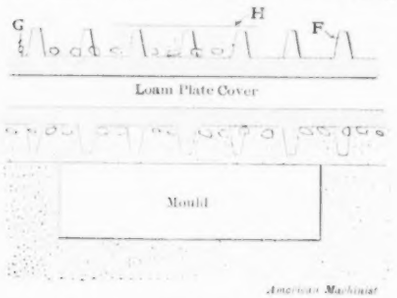


FIG. 4. A LOAM PLATE COVER.

damper sand, it is often a good plan in case of very thick castings or those exposing the top or cope surface over one minute to the rising metal's heat to dampen the finished cope surface with water; or, better still, to mix half a pint of molasses with two or three gallons of water, and blowing it on with a sprayer or applying with a brush.

Another plan often adopted is to "skin dry" the top, or to use a loam plate covering. Loam plate covering is used only in copes for massive castings or those long in filling. This is made by casting plates with prickers, as at *F*, Fig. 4, covering the surface with fine cinders and wetting them with clay wash, as at *G*, and then a strong mixture of loam, wet to a mud state, is packed up to a level as at *H*, after which the whole is thoroughly dried in an oven or otherwise.

METHODS OF VENTING AND KINDS OF VENT WIRES USED.

The methods used for venting copes are determined by the density and dampness of the sand, also by the class of work being made.

The sizes of vent wires used range from ⅛ to 5-16 inch, the larger being used for heavy work, and the deeper the venting or cope, the larger the wire necessary. A feature that will strike some as being unscientific and which will be new to many lies in the difference seen in the points of the vent wires at Fig. 5. A novice in their use would select *K* as the one to

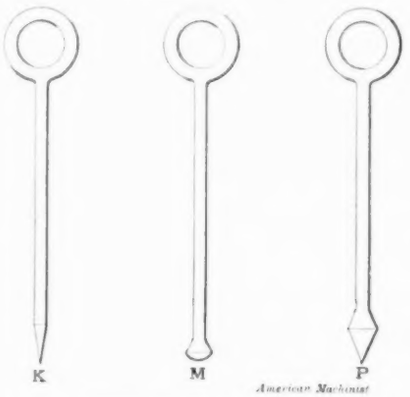


FIG. 5. DIFFERENT FORMS OF VENT WIRES.

offer the least resistance to force when being pressed into the rammed sand. A trial of both *K* and *M* will surprise the novice with how much less force is required to press *M* than *K*. Some, to obtain advantage of the point feature, combine the two to have vent wires appear as at *P*, but the point does not give the ease that one would think it should. In the case of wires over ¼ inch diameter *P* is, however, a good style to adopt.

A Spherical Boring Tool for the Drill Press.

BY LOUIS W. G. FLYNT.

This tool was designed for the purpose of boring spherical holes in the ends of connecting rods which form part of the "Columbia" beading and turning machine used in the manufacture of shoes. It may be used in any ordinary drilling machine.

It is evident that the proportions of the tool may be varied for different sizes of holes. In this particular case the problem was to bore spherical holes 1⅜ inches diameter through stock 9-16 inch thick. A parallel hole 1¼ inches diameter is first drilled with an ordinary twist drill, and the hole is then finished with the tool shown.

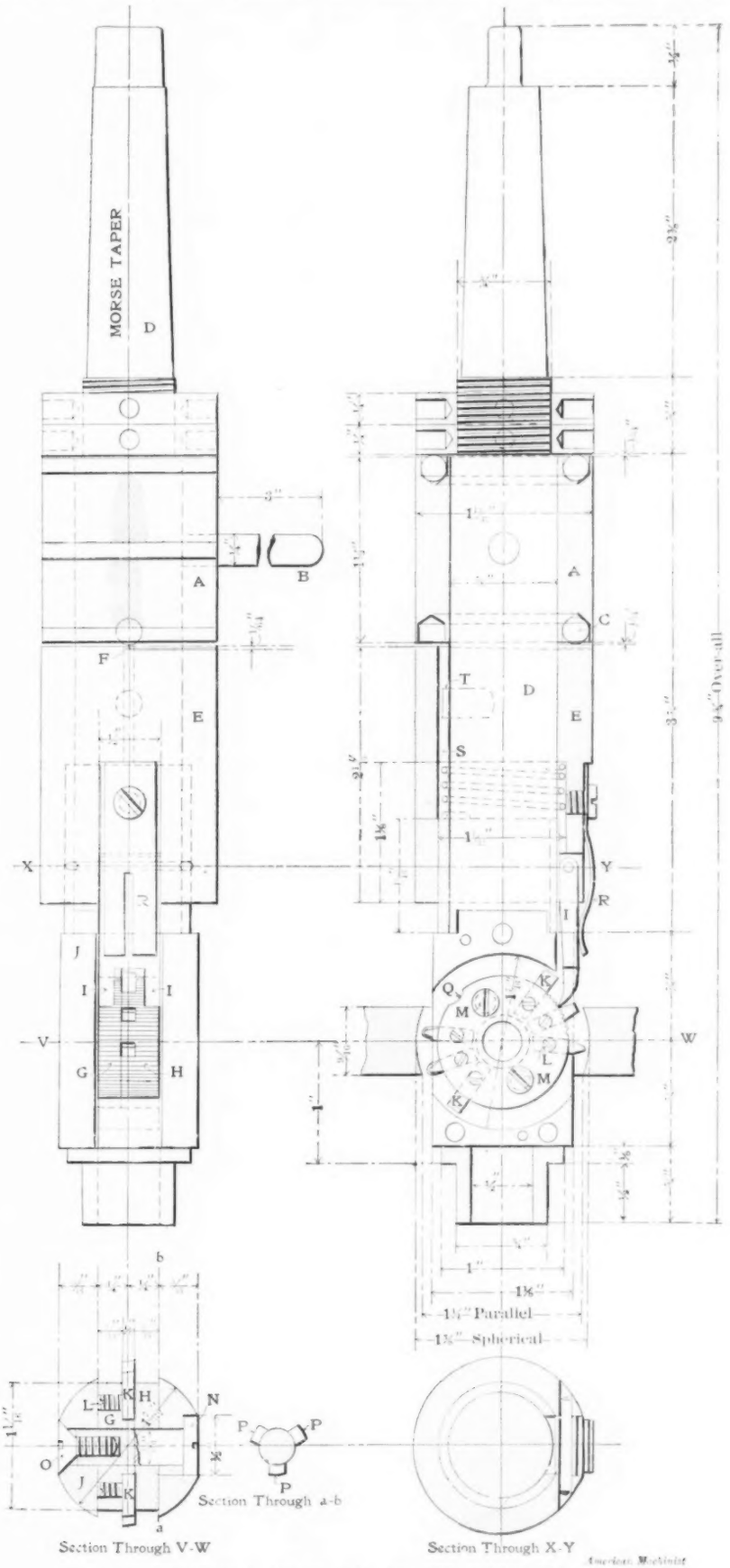
The tool consists of a spindle adapted for use in the usual drill-socket, and having near its lower end a drum-shaped cutter-head, which is housed in a slot, this cutter-head being free to rotate on a pin and carrying six small cutters. On rotating the spindle and cutter-head simultaneously on their respective axes the spherical hole is formed, the velocity of rotation of the spindle determining the cutting speed, and that of the cutter-head the feed. This will be easily followed from the longitudinal section.

The cutters are in two sets of three, each set comprising two tools for roughing and one finishing tool. The finishing tools naturally project farthest from the holder, and as the spherical surface is traversed twice by these two tools, a good working surface is secured. The cutting edges of the finishing tools are ground to the radius of the desired sphere while fixed in position in the cutter-head, which is rotated on a pin. They are gaged as to diameter by the micrometer.

One of the salient features is the method by which the difficulty of obtaining a sufficiently slow rate of feed has been overcome. When the sleeve *A* is restrained from rotating by means of the handle *B*, it will be seen that the ball *C* makes only one revolution for two rotations of the spindle *D* and of the sleeve *E* attached to it. This sleeve is capable of a slight vertical movement, being held up to the ball by means of the spring shown. The top face of the sleeve is an inclined plane or helix, and there is a sharp drop from the top to the bottom of this plane, as shown at *F*. Thus the sleeve is slowly pressed downward during two turns of the spindle and returns upward very rapidly. The time taken by the upward or idle stroke is a very small proportion of the downward or feeding stroke, and consequently the feed is practically constant. The teeth in the two halves of the cutter-head *G* and *H* are not in line, but are offset half a tooth from each other. The stroke of the pawl-points is slightly more than half of that necessary to advance one complete tooth. Therefore each stroke of the sleeve *E*—and consequently of the pawls *I*—turns the cutter-head only half a tooth; or, in other words, two strokes of the pawls are required for each complete tooth. It will thus be seen that four rotations of the spindle advance the cutter-head only one tooth.

The main spindle *D* terminates at its upper end in a Morse taper shank for ease of attachment to common drill sockets. A hardened steel bush is pressed on the lower extremity, and rotates in a jig bushing. The jig also defines the correct hight (in this case 1 inch) of the piece to be bored. Immediately above is the housing for the cutter-head. The spindle is made of 1⅛-inch square steel, and at the housing is turned to 1 7-32 inches

diameter, clearing the original parallel hole and leaving four flats. Part of this portion is cut away and replaced by the cover *J*, which conforms to the general outline of the housing, and the use of which enables the pocket for the cutter-head and cutters to be bored. It is attached to the main spindle by means of three filister-headed screws, and its position is defined by two ⅛-inch dowel pins.



A SPHERICAL BORING TOOL FOR THE DRILL PRESS.

The cutter-head consists, as already noted, of two parts *G* and *H*, the latter having a recess in the center to receive a boss formed on the other half. The cutters *K*, which are of ⅛-inch square, air-hardening steel, are held in grooves in the disk *H* by means of headless set-screws *L*, filister-head screws *M* serving to hold the two sections of the cutter head together. The head rotates on a pin *N*, which is held in place by a flat-head screw *O*. Between the head of the pin *N* and the cutter-head three grooves are cut, as shown in the section through *a b*, and in each groove is fitted a piece of rawhide *P*. Upon tightening the screw *O*, these rawhide pads are pressed against the cutter-head and prevent it from returning while the pawls make their idle stroke. The teeth cut on the periphery of the cutter-head are 3 degrees pitch, so that if continued all round there would be 120 of them. They are, however, interrupted for a short distance at *Q*, so that when this gap arrives opposite the pawl-points the feed stops automatically. In this position the cutters are so located that the tool can be withdrawn from the work, a half turn of the cutter-head then being necessary before starting in a fresh hole.

The pawls *I* are of equal length and cut away to clear the cutters *K* as shown. They are held up by a bifurcated spring *R*, and work on a ⅛-inch pin.

Immediately above the cutter-head housing a bush is slipped over the spindle to form an abutment for the coiled spring. This bush is cut away longitudinally for a width of ½ inch, to clear the pawls, and a small part of the housing is cut away for the same purpose. The spring is of 1-16 inch steel wire, and has a pitch of about ⅛ inch when at work. Its object is referred to elsewhere.

The sleeve *E*, bored to fit the spindle at its upper portion, is provided with a keyway *S*, which receives a key *T* fixed in spindle with which the sleeve rotates. The lower portion is bored larger so as to accommodate the spring and the bush. A flat is formed on the outside to facilitate the securing of spring *R*, and a little lower a slot ½ inch wide is cut out longitudinally to admit the pawls, the hole for the pawl-pin being drilled near the upper end of this slot.

The sleeve *A* is free to rotate relatively to the main spindle. If allowed to turn with the latter—being thus stationary in relation to it—no vertical movement of the sleeve *E* will take place and no feed will be imparted to the cutters. If, however, sleeve *A* is prevented from rotating by means of the handle *B*, feed at once commences as the ball *C* travels round in its race, and the sleeve *E* and the pawls are actuated as already described. Sleeve *A* is provided with a ball-thrust bearing

at its upper end, and two lock-nuts serve to hold the feeding gear in correct position. An automatic arrangement might have been provided to prevent the sleeve from turning, but this was deemed unnecessary owing to the ease with which it may be held with the apparatus as described.

The cutter-head and the pawls are made of tool steel, hardened and tempered. The spindle is of machinery steel, as also are the sleeves; but the latter are case-hardened.

The time taken to bore one spherical hole, including setting the piece in the jig and removing it, is five minutes.

High-Speed Tool-Steel Tests.

BY THE LODGE & SHIPLEY MACHINE TOOL CO.

The report of Dr. J. T. Nicholson on experiments with rapid-cutting steel tools, as given at pages 1620 and 1658, Vol. 26, has afforded many valuable data and much information on this very important and highly interesting subject. The Lodge & Shipley Machine Tool Company were one of the first to adopt the Taylor-White process of treating steels for high-speed cutting tools and have followed it up by trying nearly every other high-speed steel that has been offered. Frequently quite an improvement would be noted and a quantity purchased, only to find something later apparently much better. The subject thereby became very complex

High-speed steels are now so numerous that it has become necessary to select one of them, if possible, for universal use and thereby cut down the great variety now scattered about the shops, preventing the maximum speeds of all tools being maintained, as no standard speeds can be definitely fixed and successfully maintained under such conditions.

We have, while testing one of our high-speed lathes, which has been designed to meet the new conditions and requirements brought about by these new steels, conducted several series of experiments to determine the relative value of the several high-speed steels and what speed limit it is possible to maintain, also to fix the relative breaking-down point of each grade of steel tested. The lathe used was a Lodge & Shipley 20-inch, equipped with a high-speed headstock, tailstock and double tool-rest. The spindle is exclusively gear driven, with two changes of speed—the ratios from pulley to spindle being 3:1 and 9:1. The changes are instantly secured by sliding gears operated by a hand-wheel in the front of the headstock. The tailstock is very massive and held down to the shears by four heavy bolts running through to the top of the spindle barrel. The carriage is equipped with two plain rests, both operated by telescoping screws and the same hand-wheel, which has a clutch in each end of the hub to engage with either front or back rest screw, as may be desired. The front tool-rest has a transverse adjustment to permit easy setting of the tools and the dividing up of the cut when necessary. Otherwise the lathe as used was a Lodge & Shipley 20-inch swing with their well-known change gear mechanism.

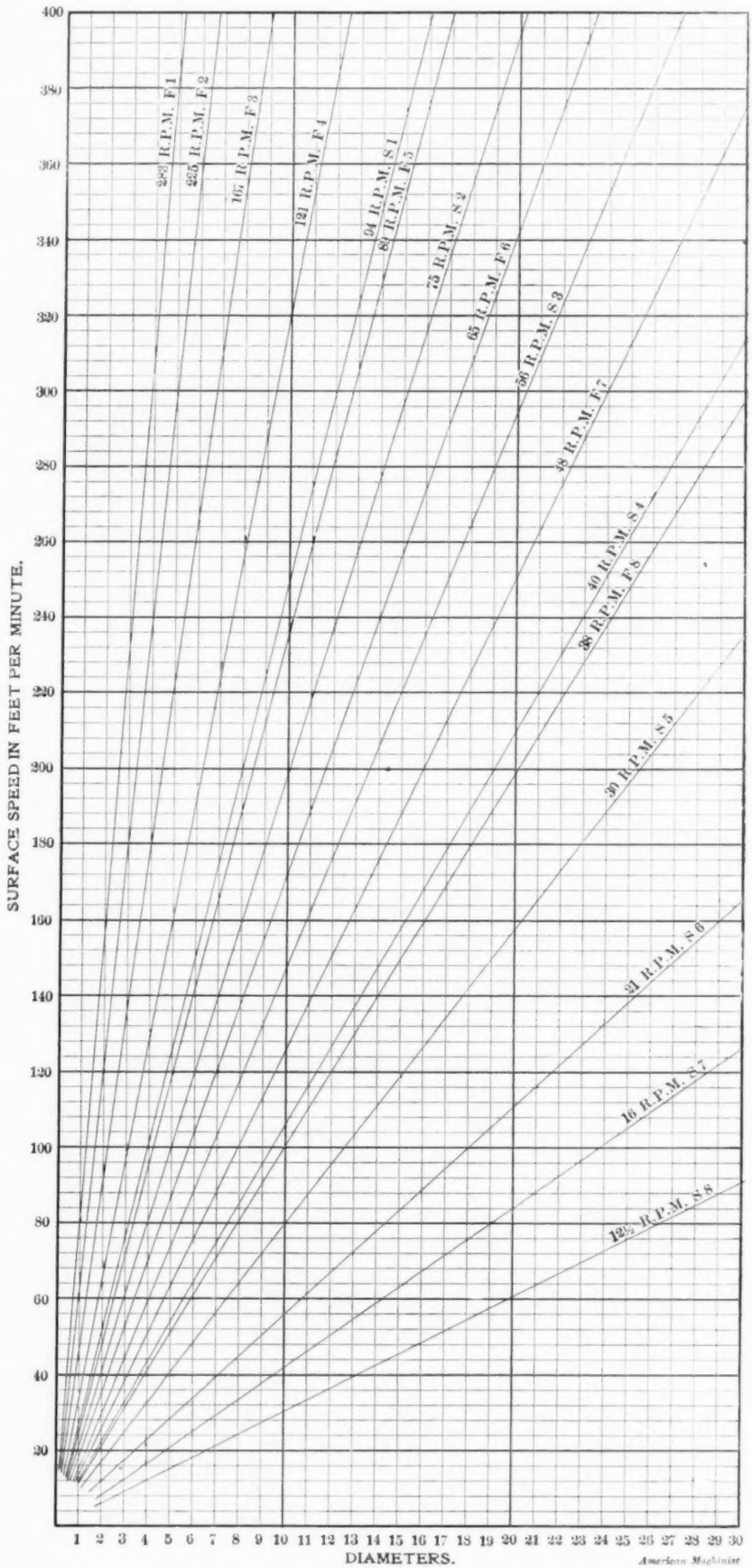


FIG. 1. SPEED CHART OF HIGH-SPEED LATHE.

The power was derived through a 6-inch belt from a No. 3 Chard variator mounted on the ceiling and belted from the line shaft. This variator gives eight changes of speed, secured instantly without stopping the lathe. With the constant shaft running at 235 revolutions per minute we secured at the variable shaft of the variator 637, 506, 376, 272, 200, 146, 108 and 85 revolutions per minute.

In Fig. 1 we diagrammatically depict the surface speeds obtainable. Read the surface speeds in feet per minute at the left of the diagram, and the diameters at the bottom. The diagonals represent the speeds secured in turns per minute. To illustrate: With No. 1 variator speed and the rapid gear speed of headstock engaged, we secure at the spindle 283 revolutions per minute represented by the first diagonal at the left labeled 283 *F*-1, *F* referring to the fast speed of the headstock and *S* to slow speed, the numeral following being the number of variator speed ranging from the highest to the lowest. The intersection of the vertical line representing the diameter, with the diagonal line representing turns per minute, gives the surface speed at the left. Likewise the speed most available for a given diameter and surface speed can be found at the intersection of the diameter and surface speed, selecting the nearest speed found either above or below the surface speed desired if it does not fall on the intersection.

For tools, we selected seven brands of the well-known high-speed steels and labeled them *A*, *B*, *C*, *D*, *E*, *F* and *G*, respectively. Several tools of each were made, all of the same size, shape and angles. These were then numbered consecutively thus: *A*-1, *A*-2, *A*-3, *A*-4, *B*-5, *C*-6, *C*-7, *D*-8, *D*-9, *E*-10, *F*-11, *F*-12 and *G*-13, and are so referred to in the tables and reports.

The limit tests shown in Table 1 were made with a 5⅛-inch diameter bar of machine steel taken from stock containing about .18 per cent. carbon. Preliminary tests were made while removing the scale on this bar to determine in about what order the tools might stand so as to give the better ones the higher speeds in the final tests. Cuts of ¼ reduction or ⅛ depth by 1/20 feed were then made, the results of tests 129 to 136 being shown in Table 1. Here No. *A*-2 tool is shown with the highest surface speed, and in spite of this handicap leads all the others in duration of cut, while *B*-5 and *E*-10 made the best showing of the balance. The bar was then turned around and light cut tests made with 1-40 feed and 1-32 depth of cut, tests 154 and 179 being illustrated in Table 1. We succeeded in obtaining speeds as high as 361 feet per minute in test 154, at which *A*-2 tool stood up to a total longitudinal feed of 23 inches, far in the lead of all the other tools. Here again *B*-5 and *E*-10 lead the balance with *G*-13 making a fair showing.

Tests on cast iron were then made, using a casting 8 inches diameter and 12 inches long, as clean of sand as could be secured, and of about medium grade iron. After removing the scale, the light cut tests were run, as shown in Table 2, 191 to 199, with 1-20 feed and 1-16 depth of cut at 184 feet surface speed. Here some of the tools broke down instantly, and most of the others made but little better showing; tool *A*-2 being the only one to run across the casting, with *B*-5 leading the balance. With a medium cut, 1-10 feed and ⅛ depth and about 119 feet surface speed, most of the tools made a little better showing, the *C*, *D* and *E* tools, however, breaking down more quickly than at the lighter cut and higher speed. Here again *A*-2 tool made a record showing, running 1½ times across the casting with a total of 15 inches longitudinal feed to its credit without breaking down. *B*-5 again made the best showing of the balance, with two other tools of *A* brand falling in the rear, but still leading all the others. The result of these tests show that brand *A*, of air hardening steel tempered at a high heat in oil, is far superior to all the others we have tested. All of the above tests were run dry.

Experiment No.	Feed	Depth of Cut	Cutting Speed in ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch	Remarks
			LIGHT CUT			
154	1/40	1/32	361	3-32	25	A 2 Tool Limit
163	1/40	1/32	337	-51	6	B 5 " "
167	1/40	1/32	328	-30	3 1/2	C 6 " "
168	1/40	1/32	326	-15	1 3/4	D 8 " "
170	1/40	1/32	319	-55	6 1/2	G 13 " "
173	1/40	1/32	305	2-32	18	E 10 " "
178	1/40	1/32	306	1-4	1/2	F 11 " "
179	1/40	1/32	296	-8	1	F 12 " "
			MEDIUM CUT			
129	1/20	1/8	201	1-49	14 1/4	A 2 Tool Still O K
130	1/20	1/8	191	-25	3 1/2	C 6 Tool Limit
131	1/20	1/8	191	-11	1 1/2	C 7 " "
132	1/20	1/8	191	-36	5	D 9 " "
133	1/20	1/8	191	-22	3	D 8 " "
134	1/20	1/8	186	-32	4 1/2	B 5 " "
136	1/20	1/8	180	-43	6	E 10 " "

Stock about 5" dia.

Stock about 4 7/8" dia.

TABLE 1 MEDIUM MACHINERY STEEL

Experiment No.	Feed	Depth of Cut	Cutting Speed in ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch	Remarks
			LIGHT CUT			
191	1/20	1/16	187	2-20	11	A 2 Tool Limit
193	1/20	1/16	184	-13	1	D 8 " "
194	1/20	1/16	184	-3	1/4	F 12 " "
195	1/20	1/16	184	-13	1	C 6 " "
196	1/20	1/16	184	-13	1	D 9 " "
197	1/20	1/16	184	-13	1	E 10 " "
198	1/20	1/16	184	-13	1	G 13 " "
199	1/20	1/16	184	-32	2 1/2	B 5 " "
			MEDIUM CUT			
212	1/10	1/8	119	-2	1/4	C 7 Tool Limit
213	1/10	1/8	119	-2	1/4	D 9 " "
214	1/10	1/8	119	-16	5	B 5 " "
215	1/10	1/8	119	-2	1/4	E 10 " "
216	1/10	1/8	119	-27	3	A 1 " "
218	1/10	1/8	114	-18	2	A 3 " "
219	1/10	1/8	114	3-18	15	A 2 " "
221	1/20	3/16	106	2-16	9	A 2 Tool Still O K
222	1/20	1/2	94	2-16	9	A 2 " " "

Stock about 7" dia.

TABLE 2 MEDIUM CAST IRON

COMPARATIVE TESTS OF SEVEN HIGH-SPEED STEELS. ALL TOOLS OF SAME SHAPE AND SIZE, BUT TREATED BY DIFFERENT METHODS IN TEMPERING.

We then supplemented these tests by several for endurance, using the two brands of steel showing the best records in the limit tests. We selected twenty-five back-gear sleeve forgings made from machine steel of about .18 per cent. carbon, rough forged, with an allowance of ¼ inch in diameter for finish on the small diameter and ⅜ inch for the large diameter. These forgings were unpickled, being centered and faced to length only before the operations recorded herewith. As the larger diameter was not always forged true to the smaller diameter of the forging, there was here a very irregular cut of from ⅛ to ¼ depth, but averaging 3-16. These forgings were rough finished to 2⅝ and 4½ diameters, leaving only sufficient for grinder finishing. The record of this

series of tests, which were run wet, is shown in Tables 3 and 4, in which tests 223 to 237 show that we used two tools, one in each rest, the back tool removing only sufficient to keep under the skin of the forging most of the time. Both tools required regrinding after finishing eight forgings at a total of 152 inches longitudinal feed of tool at a surface speed of 169 feet. After regrinding the tools, seven pieces were finished when the back tool broke down, the front tool, however, being still in a very fair condition. We then tried a single tool, *A*-2, and finished nine pieces, or one more than the full run of the double tools, and found the tool still good for further use. The condition of the tool being somewhat interesting, we exhibit it in Fig. 2. The friction of the chip curling from the tool has worn a concave spot ¼ inch in diameter and .025 deep on top of the point, while there is no evidence of wear on the cutting edge. The outlasting of the single tool over the double ones we attribute to hard spots in the forging, as in the later tests on bar stock we have demonstrated a saving in the use of two tools to divide up a heavy cut. Test 247 was then made with *B*-5 tool, but it failed before the full length of the forging was covered. The large diameter was then machined with the same feed, but with about 155 feet surface speed, using *A*-1 tool, which stood up to finish fourteen pieces before regrinding. *A*-3 tool was then used to finish the balance, or eleven forgings, leaving it in very fair condition at the finish.

In Table 5 a subsequent run on the rough turning of sixteen shafts from 2¼ machine steel is recorded, the ends being reduced to 1½ diameter by 7¾ long and 1-13/16 diameter by 14 inches long in one cut, respectively. This was done with two tools of brand *A* steel oil hardened, placing

FIG. 2. A TOOL AFTER THE TESTS.

one tool in each rest and dividing the cut equally between them. Sixteen shafts were rough turned to the dimensions given without removing the tools from the rest, and they still remained in a condition suitable for further service without grinding.

Previous to the experiments above recorded, we made several tests with the same lathe driven by motor through the same variator but at a higher speed, the constant shaft of the variator running at about 285 revolutions per minute. We secured volt and ammeter readings during these tests, from which the horse-power of cuts taken were calculated. In Table 6, tests 87 to 116 show the horse-power consumed by lathe, variator and cut, while tests 108 to 112 give the horse-power of cut only. It was quite clearly demonstrated during these tests that at the higher speeds much more power was consumed to remove a given amount of metal than at the slower speeds; also that the angle of the tool made quite a difference, as is illustrated by tests 87, 88 and 89, each being under the same conditions, except that the angle of the top of tool was changed in each case. In test 111, 1-20 feed, ½ inch depth cut at 160 feet surface speed, the ammeter reached the limit, and we were unable to say how much over 30 horse-power was consumed in the cut. However, at times the hand vibrated back of the pin slightly so that reading was taken. Tests 87 to 106 were made upon a lot of back-gear sleeve forgings similar to but larger than those used in the tests shown in Tables 3 and 4. In tests 99 to 106 are recorded the total time of turning and handling, in which the lathe hand unassisted rough turned the long end of eight forgings in 24 minutes, or at the rate of 200 in ten hours. We are doubtful if he could have maintained this rate all day, however. The tool used was of the *A*

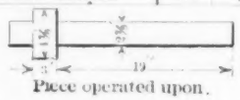
Experiment No.	Feed	Depth of Cut	Cutting Speed in ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch.	Remarks
223	1/20	1/8	169	1-40	19	
224	1/20	1/8	169	1-40	19	
225	1/20	1/8	169	1-40	19	
226	1/20	1/8	169	1-40	19	Finished 8 Forgings
227	1/20	1/8	169	1-40	19	when tools required
228	1/20	1/8	169	1-40	19	regrinding
229	1/20	1/8	169	1-40	19	
230	1/20	1/8	169	1-40	19	
231	1/20	1/8	169	1-40	19	
232	1/20	1/8	169	1-40	19	
233	1/20	1/8	169	1-40	19	Finished 7 Forgings
234	1/20	1/8	169	1-40	19	when back tool required
235	1/20	1/8	169	1-40	19	regrinding
236	1/20	1/8	169	1-40	19	
237	1/20	1/8	169	1-40	19	
238	1/20	1/8	169	1-40	19	
239	1/20	1/8	169	1-40	19	
240	1/20	1/8	169	1-40	19	
241	1/20	1/8	169	1-40	19	Single A2 tool used
242	1/20	1/8	169	1-40	19	Finished 9 Forgings
243	1/20	1/8	169	1-40	19	and tool still in
244	1/20	1/8	169	1-40	19	good condition
245	1/20	1/8	169	1-40	19	
246	1/20	1/8	169	1-40	19	
247	1/20	1/8	169	1-40	15	Tool B5 Limit Finished with A2

2 Tools A2 & A1 front & back

TABLE 3.

Experiment No.	Feed	Depth of Cut	Cutting Speed in ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch.	Remarks
248	1/20	1/16 to 1/4	155	1	3	
249	1/20	1/16 to 1/4	155	1	3	
250	1/20	1/16 to 1/4	155	1	3	
251	1/20	1/16 to 1/4	155	1	3	
252	1/20	1/16 to 1/4	155	1	3	
253	1/20	1/16 to 1/4	155	1	3	Tool A1 Finished
254	1/20	1/16 to 1/4	155	1	3	11 Forgings when
255	1/20	1/16 to 1/4	155	1	3	tool required
256	1/20	1/16 to 1/4	155	1	3	regrinding
257	1/20	1/16 to 1/4	155	1	3	
258	1/20	1/16 to 1/4	155	1	3	
259	1/20	1/16 to 1/4	155	1	3	
260	1/20	1/16 to 1/4	155	1	3	
261	1/20	1/16 to 1/4	155	1	3	
262	1/20	1/16 to 1/4	155	1	3	
263	1/20	1/16 to 1/4	155	1	3	
264	1/20	1/16 to 1/4	155	1	3	
265	1/20	1/16 to 1/4	155	1	3	
266	1/20	1/16 to 1/4	155	1	3	Tool A3 Finished
267	1/20	1/16 to 1/4	155	1	3	11 Forgings and
268	1/20	1/16 to 1/4	155	1	3	tool still in good
269	1/20	1/16 to 1/4	155	1	3	condition
270	1/20	1/16 to 1/4	155	1	3	
271	1/20	1/16 to 1/4	155	1	3	
272	1/20	1/16 to 1/4	155	1	3	

TABLE 4.



Piece operated upon.

ENDURANCE TESTS OF THE TWO HIGH-SPEED STEELS WHICH GAVE THE BEST RESULTS IN THE PREVIOUS TESTS. MATERIAL OPERATED UPON, MACHINERY STEEL. BACK GEAR SLEEVE FORGINGS AS PER SKETCH ABOVE.

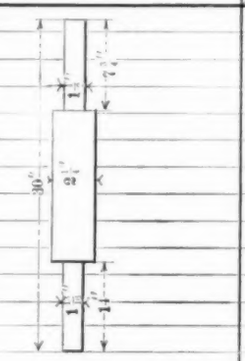
Experiment No.	Feed	Depth of Cut	Cutting Speed in Ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch	Remarks
275	1/80	7/32	167	2-10	7 3/4	
276	1/80	7/32	167	2-10	7 3/4	
277	1/80	7/32	167	2-10	7 3/4	
278	1/80	7/32	167	2-10	7 3/4	
279	1/80	7/32	167	2-10	7 3/4	
280	1/80	7/32	167	2-10	7 3/4	
281	1/80	7/32	167	2-10	7 3/4	
282	1/80	7/32	167	2-10	7 3/4	
283	1/80	7/32	167	2-10	7 3/4	
284	1/80	7/32	167	2-10	7 3/4	
285	1/80	7/32	167	2-10	7 3/4	
286	1/80	7/32	167	2-10	7 3/4	
287	1/80	7/32	167	2-10	7 3/4	
288	1/80	7/32	167	2-10	7 3/4	
289	1/80	7/32	167	2-10	7 3/4	
290	1/80	7/32	167	2-10	7 3/4	Lot finished to above dimensions at each and before tools required regrinding
291	1/80	7/32	167	3-58	14	
292	1/80	7/32	167	3-58	14	
293	1/80	7/32	167	3-58	14	
294	1/80	7/32	167	3-58	14	
295	1/80	7/32	167	3-58	14	
296	1/80	7/32	167	3-58	14	
297	1/80	7/32	167	3-58	14	
298	1/80	7/32	167	3-58	14	
299	1/80	7/32	167	3-58	14	
300	1/80	7/32	167	3-58	14	
301	1/80	7/32	167	3-58	14	
302	1/80	7/32	167	3-58	14	
304	1/80	7/32	167	3-58	14	
305	1/80	7/32	167	3-58	14	
306	1/80	7/32	167	3-58	14	
307	1/80	7/32	167	3-58	14	

TABLE 5

ROUGH TURNING OF MACHINERY STEEL SHAFTS AS PER SKETCH.

Experiment No.	Feed	Depth of Cut	Cutting Speed in Ft. per Min.	Duration of Cut in Min.	Total Longitudinal Feed of Tool in Inch	H. P. Machine & Cut	Remarks
87	2/15	1/16	175	50″	21	17	
88	2/15	1/16	175	50″	21	19	
89	2/15	1/16	175	50″	21	13.6	
90	1/5	1/16	175	40″	21	15.9	
99	1/10	1/16	121	1.28	21	7.2	
100	1/10	1/16	121	1.28	21	7.7	
101	1/10	1/16	121	1.38	21	7.1	Back Gear Sleeve Forgings. Total time handling and turning 8.34 min = 20 per hour
102	1/10	1/16	121	1.38	21	9	
103	1/10	1/16	121	1.38	21	9	
104	1/10	1/16	121	1.38	21	7.7	
105	1/10	1/16	121	1.38	21	8	
106	1/10	1/16	121	1.28	21	7.2	
113	1/10	5/8	66		6	15.4	
114	1/80	1/32	342	1.40	7	3.4	
116	1/40	1/16	340		11	5.4	
108	1/30	1/2	108		24	15	
109	1/22	1/2	128		24	17	
110	1/20	1/2	128		24	19	
111	1/30	1/2	160		24	30+	
112	1/8	1/2	92		24	22 1/2	

TABLE 6

HORSE-POWER TESTS.

American Machinist

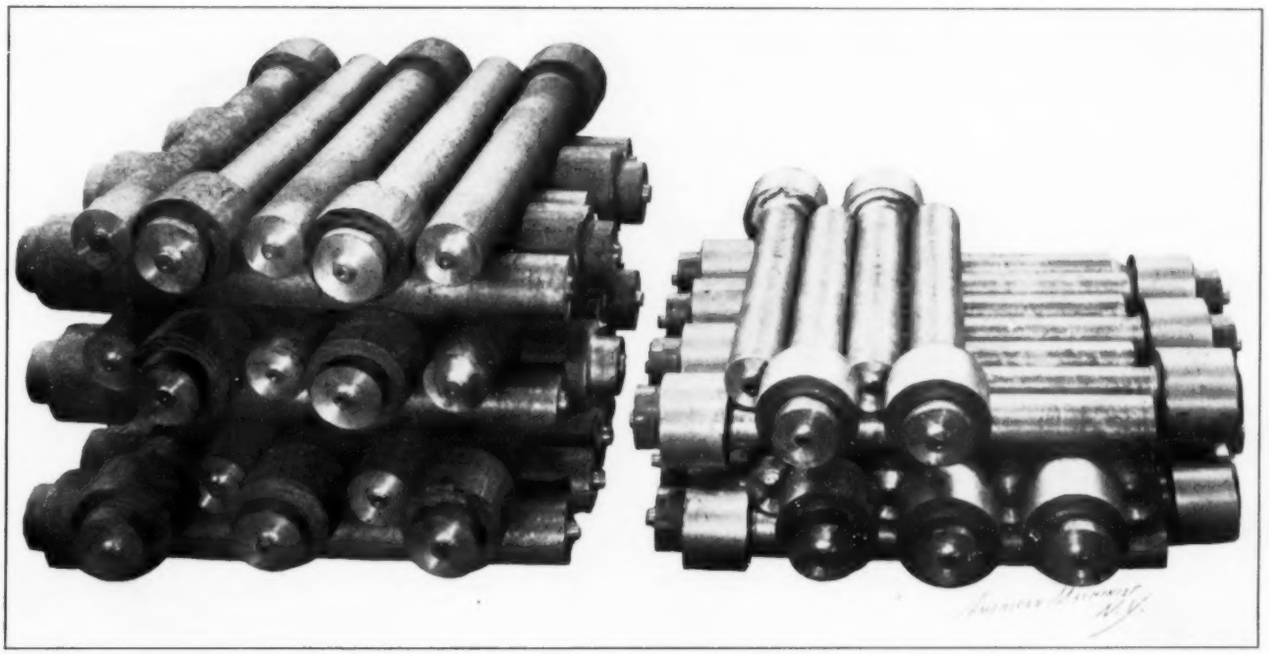


FIG. 3. SOME OF THE WORK DONE.

brand oil hardened, and was in very good condition at the close of the experiment.

Fig. 3 shows the forgings as rough finished in experiments 87, etc., and 223 to 247. The larger pile contains thirty pieces rough turned on the long end only and represents 1½ hours' work had the same speed been maintained for the lot as was recorded on eight of them in tests 99 to 106, inclusive. A few heavy cuts were then made reducing a bar of medium machine steel one inch in diameter with one tool of brand *A* oil hardened, and 24 inches of longitudinal movement of the tool at several speeds and feeds were made without breaking down the tool.

Summing up the results of these tests, it would appear that with the brand of steel we have marked *A* oil hardened, it is feasible to maintain much higher speeds than the those deduced from Dr. Nicholson's experiments, and we are in many cases living up to these corclusions in our every-day shop practice.

Molding a Slewing Crane Girder.

BY JOSEPH G. HORNER.

The casting shown in Fig. 1 formed the center girder of a very large slewing crane, it being about 3 feet deep in the body, 4 feet wide in the middle and nearly 10 feet long. It pivots or slews by its central hole upon a central pin, the latter forming part of a foundation casting, and it carries the main uprights upon which the whole superstructure of the crane is built. These uprights, two in number, fit upon the broad portion *A* of the top and against the ribs *B*. A stout bolt passes through the hole *C* and secures the girder and foundation together against any surging movement, while permitting freedom to slew.

The general construction of the pattern is indicated by the direction of the timber

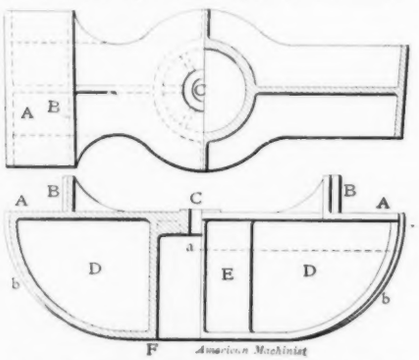


FIG 1. CASTING FOR FOOT OF LARGE SLEWING CRANE.

shading in some of the figures that illustrate the molding. The only portions which must not be fastened permanently are the top plate, of which *A A* form a part, and its wings *B* and their brackets. Before considering the molding, we may briefly consider a few points in the method of construction of the pattern. Comparisons may be made between the casting, Fig. 1; the end view of the pattern, Fig. 2; its side view, Fig. 3, when bedded in, and its plan, Fig. 6, as it lies after the sides of the mold have been rammed.

As the central web *D* is about 3 feet deep, it is made in three pieces, with open joints. These pieces are held together at the center by means of the central boss *E*, which is lagged up, being 2 feet 3 inches

FIG. 2

to suit the taper of the long uprights which rest thereon, the latter being closer together at the front end of the crane, where the lifting pulleys come, than at the back end, where the engines and hoisting drum and gearing are located. The taper on the girder itself is not of large amount, but it is quite sufficient to make so much under-

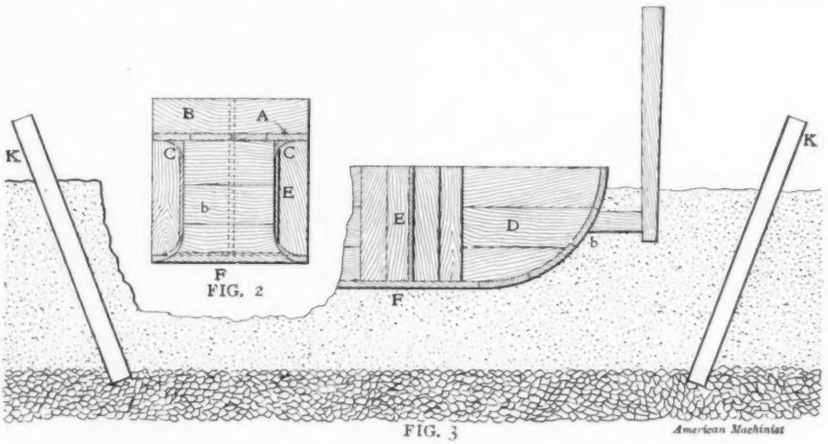


FIG. 3

SHOWING CONSTRUCTION OF PATTERN AND BEGINNING OF MOLD.

diameter, and at the ends by means of the curved ribs *b b*, which are made in sections of about a foot wide, and fastened by screws right upon the curved ends of the web. The curved parts which form brackets *c c*, underneath the broad parts *A A* of the top plate, are loose, being held temporarily with skewers, the reason of which will be clear in the course of the molding. The top plate *A A* is doweled upon the top edge of the web *D* and of the ends, and a few screws are put in also from the top to prevent it from lifting out of the plate during the ramming. The flanges *B B* and their brackets are screwed to *A* and assist to keep its broad plate true.

Looking at the casting in plan, Fig. 1, there is one little thing that prevents the molding being done with the joint along the center line, that being the method which would first suggest itself; that is, that the ends of the casting are tapered cut as to preclude the possibility of lifting the sand from the interior at the ends. For this reason, therefore, the girder is molded with the plate *A A* in the top. The bottom plate *F* and the curved flanges *b b*, which connect the bottom to the ends, cannot be lifted until the mass of sand which lies between them and the top of the plate has been removed. This sand has therefore to be taken away on drawback plates after the top portion of the pattern is removed and before the bottom and curved flanges can be lifted.

The base of the mold is a coke or cinder bed, Fig. 3, rendered necessary because of

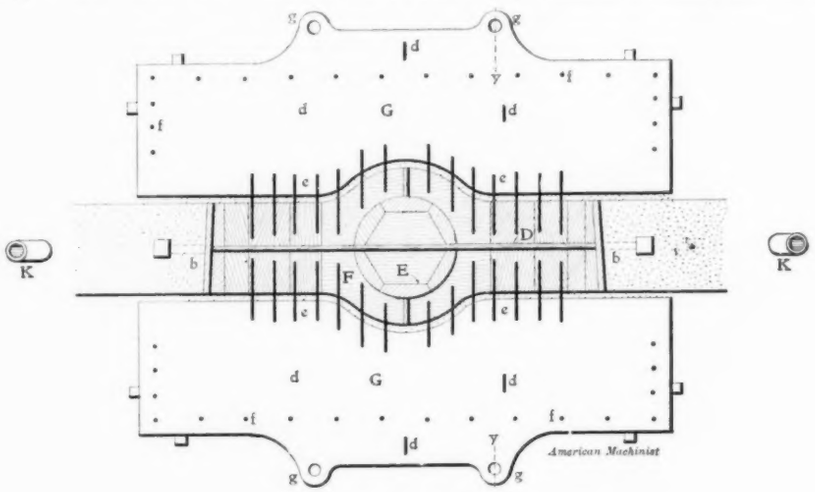


FIG. 4. PLAN OF GRIDS.

the large area of the bottom flange from which the air has to be carried off through the vent pipes *K K*. This bed has an area larger than the flange—compare with Fig. 5—and is 6 or 8 inches deep. It is covered with a thin stratum of hay and several inches of sand, upon which the bottom of the pattern is then bedded. The

pattern has to be laid down and removed three or four times, in order that the bedding may be perfected. At each removal the sand is tried with the fingers and rammed and re-rammed until of equal consistency. It is pierced with numerous vents reaching down to the cinder bed. The pattern is made to bed thus along the flat bottom, and around the outsides of the curved flanges up to the ends, Fig. 3.

At the same time the runners and ingate sticks are rammed in, the casting being poured at the two ends directly into the central web. The runners are shown in position in Fig. 3, which represents the first stage of the molding just described. The view is taken against the side of the pattern, against the face of the sand upon which it is bedded, and a section through the sand and the coke bed beneath is also given.

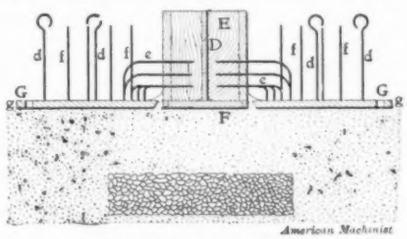


FIG. 5. SECTION ON *y y*, FIG. 4.

edges beveled (see Fig. 5). This is done to form a close yet easily fitting joint with the other portion of the mold. If the edge were square, the sand against which it abuts would be likely to become broken down, and perfect guidance for the return of the grids back into their places on the finishing of the mold would be lost. By means of these beveled edges, therefore, the grids are now set, as shown in Figs. 4 and 5, in readiness for ramming, the top plate *A A* being, as before stated, left off for the present.

The whole of the remaining portion of the mold, except the flat top with its two wings and brackets, is rammed on the two drawback plates. This includes the vertical faces of the web *D*, the boss *E*, the inner faces of the bottom *F* and of the curved flanges *b b*, and the under face and the edges of the top flange *A A*, for which the sand is strickled.

The first stage of this section of the ramming is strewing a layer of strong facing sand upon the inside faces of the bottom flange *F* and of the curved ends *b b*, for the bent rods *e* to bed down upon, the grids being temporarily removed for this purpose. When they are set back, coming down upon the facing sand, common sand is used for the bulk of the mold, facing sand being reserved only for contact with the pattern faces. After a thickness of about 6 or 8 inches of sand has been rammed up, iron rods *h h* are rammed in horizontally from the grid area to the mold area, the positions of which are indicated in the plan, Fig. 6, and by dots in the sectional view, Fig. 7. Vertical rods and S-hooks also are rammed up in places, though not indicated, right up to the top of the mold at intervals of a few inches. These various rods sustain and bind together the large mass of sand upon the grids.

The sand joint *j j*, Fig. 6, which the vertical face of the grid mold makes with the vertical face of the mold upon which the pattern was first bedded is coincident with the edges of the curved flanges *b b*. The brackets *c c* which are wired on the

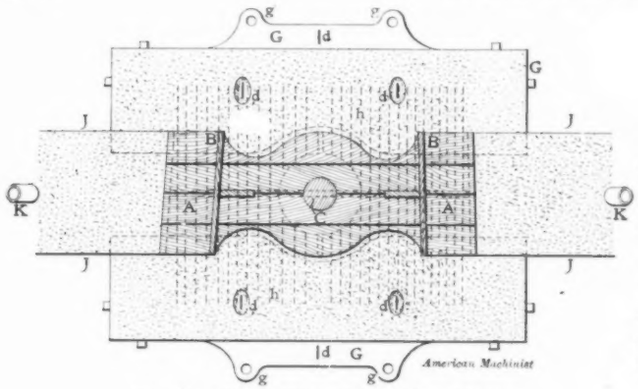


FIG. 6. HORIZONTAL SECTION OF MOLD.

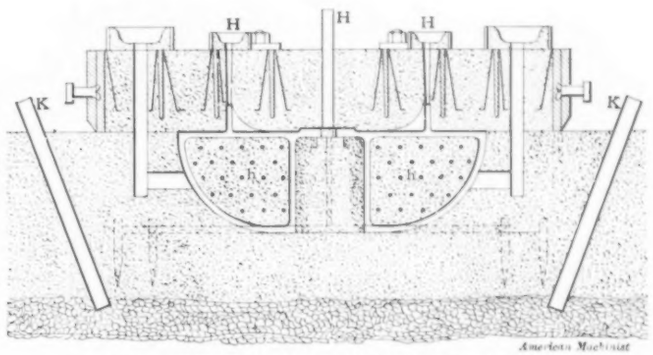


FIG. 7. VERTICAL SECTION OF MOLD COMPLETE.

The brackets *c c*, Fig. 2, underneath the top plate *A A*, are not put on the pattern until the next stage—that is, when the drawbacks are being rammed—because they come into the sand which is carried upon the drawbacks. If they were fastened in tightly, they would prevent the lifting of the drawbacks.

The two drawback plates or grids *G G* are laid one on each side of the pattern, shown in plan in Fig. 4, and in cross vertical section in Fig. 5. They are about 3 inches thick, and their general proportions can be judged from the drawings.

The plates of the grids are cast thick and massive in order that they shall carry the mass of the superincumbent sand and rods without yielding. The plates are lifted and lowered with three stout eyes *d d d* to each, cast in. Bent rods *e* are cast along the inner edges to carry the sand which overhangs the bottom and end flanges. These also are stout to prevent springing, being of 1-inch square iron. It will be noted, in Fig. 4, that they follow the shape of the pattern pretty nearly in each direction, so that the whole of the overhanging sand shall be well supported. To retain the sand around the outside edges of the plate, stout vertical rods *f* are cast in, and ears *g* are provided to receive hold-down bolts which secure the cope to the drawback plates.

The plates are made with their inside

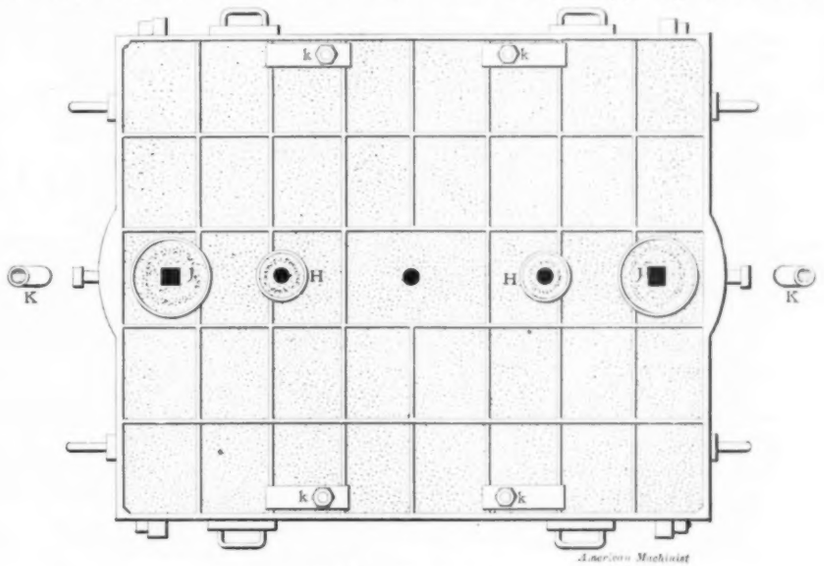


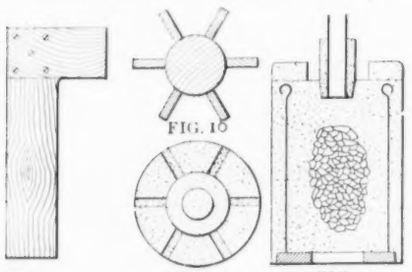
FIG. 8. TOP OF MOLD.

edges of these curved flanges, as already noted, come over into the grid sand which is rammed right up level to the top edge of the top plate *A A*, which has previously been placed on the pattern. There it is strickled off, and parting sand is dusted upon it ready for the cope. Fig. 6 shows the mold at this stage.

The ramming of the cope is simple enough. It is plain ramming, with the usual lifters. Risers *H H*, Figs. 7 and 8, are placed over the two ribs *B B* and over the central boss *E* (see Fig. 7), which gives a vertical section through the complete mold.

When the cope has been removed, the top plate *A A* of the pattern is taken away, and the grids are lifted vertically with the crane by means of their eyes *d*. Then the pattern is drawn, the runner sticks are taken out, the sand being dug away behind the horizontal ones to permit of their withdrawal, and the mold is ready for sleeking and blackening.

The central core is struck vertically in



DETAILS OF CORE WORK.

loam, with the board shown in Fig. 9. A set of wooden ribs and a boss, Fig. 10, is bedded in the top to form the ribs and boss shown in Fig. 1. The core is carried upon a plate, Fig. 12, with eyes for lowering the core into the bottom, being centered by measurement. The eyes are filled up with sand after the core is set. The top of the closed mold, Fig. 8, shows the runners *J J*, the risers *H H H*, the vent pipes *K K*, from the coke bed, and the bolts *k* which fasten the top box down to the grid plates *G*.

Bath, England.

Echoes From the Oil Country.

FOR THE GENERAL UTILITY MAN—A GENERAL UTILITY BORING BAR HOLDER.

I do not expect that this will interest the man in the big shop, where everything is planned to do each job in the best possible way and with the best possible tools; but I have a very strong fellow feeling for the man in the job shop, the fellow who is expected to do next to everything and is supplied with next to nothing to do it with. This tool is shown for the purpose of helping him out of one of the numerous holes that some new combination is digging for him. As a time saver in boring holes it beats "high-speed" steel.

Where I got the idea that grew into this tool I cannot say, but I do recall the job which brought the despair that set my brain working to find a way of escape. It was a lot of compression shaft couplings. They were for shafts 2¼, 2½ and 3 inches in diameter, and the holes were 12 inches long. The holes had to be round and straight or the couplings were a failure, and we didn't have a reamer in the shop

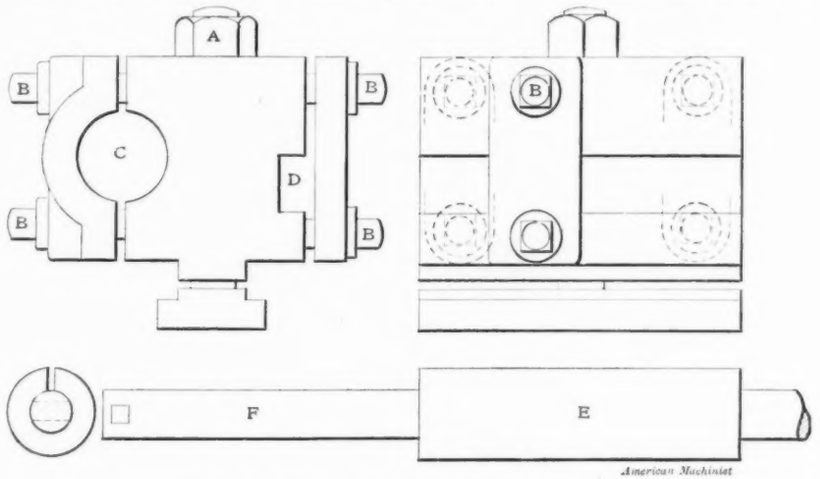


FIG. 1. A GENERAL UTILITY BORING BAR HOLDER.

of these sizes. They were held in the chuck and rotated for boring. The best plan we had thought of was to forge a cutting point on a bar of steel as large as would go through the rough hole. This point we made so that the cutting edge would stand at the center of the hight of the steel instead of being even with the top By using a long piece of steel we had a chance, by setting the tool-post as far forward as we could, of wedging the back end so that the pressure of the cut would not crowd the tool around. This worked pretty well as long as the wedges did not fall out, but it was a very expensive tool. In the first place, it was hard to get hold of a bar of steel the right size; then it was hard to get the blacksmith to get that point just right, and after he had it "just so" it took a lot of time and fussing to get the tool just the right hight in the tool-post, and setting level so that it would clear all the way through. After all these points were attended to, the tool was sure to dig into the joint between the halves of the castings and break the point off, or else find some sand holes and wear it off. In either case it meant taking the tool out and acquiring some more skill and patience (at the boss's or customer's expense) in trying to get it in again.

Oh, yes, we tried packing the couplings up on the carriage and boring the holes with a short boring bar, and could get a good job when we got it done, but "Art is short and time is fleeting," and it is not hard to wear out patience that has to be paid for by the hour.

We gave up the tool-post for this job and made special boring tool-holders. The first holders were not as good and heavy as the one shown, but every time we broke one and had to make a new one we made it heavier. The slot *D* came from a remark of one of the men who had a lot of boring and facing to do: "A man loses what he gains in boring by having to change to do the facing." It took only a few minutes to have a slot and a clamp on the side so that an Armstrong holder would fit. We make the nut *A* to fit the footstock wrench and the cap-screws *B* to fit the tool-post wrench. The hole *C* we make 2 inches, and are careful to get its center true with the centers of the lathe. The slot *D* should be made to suit the tool that it is to hold, and so located as to bring the point of the tool about on the center.

It will be understood that the bar can be pushed in or out as desired, and rolled around to any position wanted. This makes it possible to always use the shortest boring tool that the job will permit. By having a number of points with different bottom rake, to get various angles of top rake is simply a matter of rolling the bar up or down, and if the tool-slot is set angling through the end, so that the point of the tool projects beyond the end of the bar, facing can be done with it. Generally it saves time to pull the bar back close to the holder while doing the facing.

A few bushings to suit smaller bars

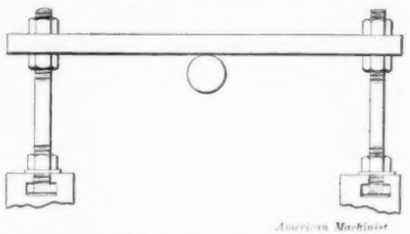


FIG. 2. CLAMP FOR BACK END OF BORING BAR.

make the holder as good for the smaller holes as it is for the others. In making the bars it is well to be liberal in the matter of length. We bore holes up to 20 inches long with a 2-inch bar, and find that the most trouble does not come from the spring of the bar but from the spring of the cross-slide. One of the men suggested an improvement that helps very

much on the long holes. We use a bar about 4 feet long. It is long enough to project out toward the footstock beyond the line of the carriage. A clamp, Fig. 2, about 1x2 inches, and as long as the distance from the front to the back of the carriage, is drilled so that when the hole in one end is over the slot in the front wing of the carriage the one in the other end is over the slot in the back wing. Two stud bolts hold it in position, as shown in the sketch. If care is taken to set the clamp somewhere near level, the bar can be moved in and out for depth of cut, etc., without paying any attention to it.

It will be seen that this arrangement eliminates the effect of the slack in the cross-slide and makes it act as a fulcrum. It may be a surprise to a great many to find out how great a factor this slack is in boring a long hole. In most lathes that I have worked with, it is where most of the spring comes from, and not from the tool, as I once supposed.

The man who has a chucking lathe, and roughing and finishing drills and reamers at hand, may not care for this, but the man with an assortment of things that he tries to think are boring tools lying upon the shelf where he keeps his spare tools, may think differently of it; and, by the way, partner, don't you think that we jobbing hands use about as little brains in having our boring tools forged as in any tools we have made?

It took me several years to know enough to use a straight bar of steel for the regular one. By putting the top of the nose at the center of the bar, the body of the tool can be made twice as heavy and still go into the same hole; and there is another good point about that kind of a tool: by packing up so as to keep the top of the tool level when the point is on the center the bar can be kept just as short as the job will allow, and at the same time the tool will do for a deep hole.

Instead of having a lot of tools of different lengths drawn out for the different jobs, just use different sized bars to have the noses forged on, and keep just as much of the bar of steel with the nose as the boss will let you and not kick. Twelve inches is not too long for a ½x1-inch tool, and 15 to 18 inches comes in very handy with a ⅝x1¼-inch one.

By forging the top of the cutter in the center of the bar a ½x1-inch tool can be used in a 1¼-inch hole, and a ⅝x1¼-inch one in a 1½-inch hole, with the added advantage that the overhang need not be any greater than the depth of the hole requires. If the tool-post on your lathe has too short a slot in it, you may have to run it up higher to use this kind of a tool; but even if you have to make a new tool-post you are ahead. It will pay you also to have a packing strip for each size of steel used, so that you will not lose any time hunting for strips when you want to raise a tool up, and then find that you have to repack it when you are half way through a long hole because your tool body is rubbing on the top or bottom, and maybe you won't find it out before the tool has gouged in and made a bad hole for you.

The man who would rather spend five minutes every time he uses a tool, hunting and fussing with his box of shims, than to spend fifteen minutes fitting up a proper piece once and then have it, properly marked, ready for use at all times, would be just the kind of a man who would have a tool rub on the end of the hole and spoil the job before he would notice it.

W. OSBORNE.

Points on Grinding.

CHATTER, WHEELS, STEADY-RESTS, SPEED OF WORK.

BY C. H. NORTON.

The phenomena of vibration have been probably the most puzzling to all of us who have been more or less familiar with cylindrical grinding for the last twenty years, or since the introduction of the "Universal Grinding Machine." They are still the cause of much, if not the majority of the misunderstandings that arise between wheel maker, wheel user, machine maker and machine user.

A French writer has said that "Thinkers are scarce as gold; but he whose thought embraces all his subject, who pursues it uninterruptedly and *fearless of consequences* is a diamond of enormous size." In studying this subject let us do so fearless of consequences. If we see our preconceived ideas falling before us, let them fall, even if they have been the accepted ideas of every mechanic we have known. It is no disgrace to have held views that must fall as we progress; and the men who advanced those ideas in the past are none the less worthy of our admiration as inventors and engineers; for they have given us what we now have, which is infinitely better than that they improved upon; and much that they gave us is elemental and still indispensable.

A short study of the evolution of the grinding wheel, the grinding machine and of ourselves may aid us in understanding the various phenomena that have caused us so much trouble. The first universal grinding machines were driven from one shaft overhead and the work was driven from a pulley of the same diameter as that which drove the wheel. As near as we can estimate from the relative size of wheel pulley and the work pulleys, the work ground on centers must have rotated about 1,000 and 2,000 per minute. As the work then ground ranged from ¼ to 2 inches diameter, we find a surface speed from 130 to 520 feet per minute.

At that time the "emery wheel" was always very tough—in fact, was a cutting tool only when "hacked" or rubbed with great force. It is evident that impressions of speed of work were created by the fact that slower work speeds caused burning of the work and "glazing" of the wheel. We must also remember that this early work was ground dry and that there was an effort made to run the work fast enough to distribute the heat equally around the work, with the belief that equal distribution would prevent bending. The wheel being tough required that the work should rotate very fast in order to rub the surface sufficiently to allow cutting. As there was not sufficient power in the wheel driving belt to allow of deep cuts, this rubbing or sharpening of the wheel had to be done by great speed of the work.

The traverse of the work past the wheel was at first about .01 inch per turn of the work, and to get to the end of a piece of work in reasonable time required rapid rotation of the work. The fact that in our early experience we removed an infinitesimal amount of stock at each pass made it possible to grind without large chatters. All the earlier work, however, would show chatter marks when lapped in a ring.

Following those early machines came the knowledge that wheels were, or could be, made of different grades and that softer grades cut more freely. With this freer cut came the experience that they wore away rapidly unless the work rotated slower; so gradually we ran the work slower until 80 to 100 feet per minute was reached for nearly all sizes and all kinds. At that point we remained for a long period, and many still insist upon retaining about that speed.

With small and narrow faced wheels we were enabled to grind without difficulty and the narrower the face the less trouble we had. Owing to this fact we for a long time used ½-inch wheels with the face narrowed to 1-16 or ⅛ inch and were content until someone a little more courageous than the rest ventured to use the "full width" of the ½-inch face and also ventured to arrange the traverse faster per revolution until ⅛ inch was reached. This met with opposition from operators but finally in the face of this opposition it was retained. With it came trouble from vibration or "chatter," and then began long experimenting with wheels as to their relation to chatter marks. When we got chatters we changed wheels until we ground without marks and the poor "wheel maker" was made responsible for *our* trouble. When by selection of wheels we could grind good work, there came a still greater increase in traverse per revolution until ¼ inch was reached. This met with opposition, but remained in some cases. With it came more trouble with chatters.

Then came experiments with steady-rests. Rests had been used always, but not on all work—in fact, on but very little of it, and then but one rest and that very light. With these experiments came many forms of rests until many spring-rests covering practically all of the length being ground were used on each piece of work, and we could grind good work with the full width of a ¾-inch face wheel and a

¼ traverse in extreme cases, ⅛ being used more commonly; the work still running at about 100 feet per minute.

Next came an effort to produce still more work by grinding, and heavier machines were made with wheels ¾ inch and 1½-inch faces and a maximum traverse of about ½ inch to the revolution of the work. With this greater trouble came from chatter, and much better rests were made to steady the work; but to-day, in most cases, I find the operator using the ¾-inch face wheel, with the belief that the 1½-inch face cannot produce good work; he is still rotating the work about 100 feet per minute in most cases, and in few is he using steady rests.

Next came a very heavy machine with wheel 2-inch face, very heavy spring rests, work speed from 80 to 90 feet per minute and a traverse of about 2 inches per revolution. This gave a larger output, but a continued effort to increase the output produced chatters, which were overcome by throwing out the springs and using rigid rests. Then again came dissatisfaction with the amount of work being done, and radical changes were made with wheels. This gave still more work, but with the increased work came a return of chatters. Next came experiments with slower work speeds, and the chatters disappeared, while the product was increased.

At the present time the best and quickest work is done at a work speed from 6 to 40 feet per minute, a wide range of surface speed of work proving necessary to high quality and large production. With this the wheels have grown coarser, softer and fewer in number of varieties, until at this time the quickest work and finest finish on soft steel is produced with a grade "L" wheel No. 24 combination. Grade "M" being used in few cases. A few years ago 80 grade "M" or "N" was the common thing.

Two years ago great care was taken to select a wheel that would not chatter; now no thought is given to this feature of the wheel, but rather the work speed is adjusted to each case, while the wheel remains the same for a wide variation in material, shape and size of work.

I refer above to experience in our own works. Many still insist that they must rotate the work faster than we do and that they must use finer and harder wheels. If they retain the speed of work they must also retain the finer, harder wheel; one cannot exist without the other. As far as my experience is concerned, chatter marks are gone forever; but there are many who are still in the toils.

Now, how may they be free, and what is the cause of chatters? Chatters are of two kinds—one a series of flat spots or lines parallel with the axis, the other a mottled marking, sometimes a spiral and sometimes irregular. The first is the result of vibrations of the work, which is caused by the wheel and work acting together during the grinding. There are perhaps a number of forces that play a part in producing the result, but we cannot at present name them, or explain their action. It is sufficient at present to know that vibration of the work is caused by the cutting of the wheel. How do we know this? Remember that we have for years selected wheels that would not "chatter"; that we for a long time turned away part of the wheel face to "make it grind steady," and that to-day, with all other factors the same, some wheels will chatter while others will not.

The following case will serve to illustrate: A piece of machine steel, about 4 feet long and 1½ inches diameter, was rotating on the centers of a grinding machine, no steady rests in contact. A coarse wheel was used to grind it; no chatter marks could be obtained. Another wheel, somewhat finer, was used, and the work was covered with chatter marks. These marks when counted proved to be seven to the inch of circumference. A deeper cut was taken and the marks showed ten to the inch. A slight cut was taken, and the marks showed sixteen to the inch. The table traverse was changed and the marks showed thirty-two to the inch. This was all done with one speed for the work. A change of work speed showed as many different marks per inch, until a speed was reached at which chatter marks were impossible. The use of steady rests enabled grinding without chatter at a faster speed than was possible without them.

The vibration shown by lines parallel with the axis is always the vibration of the work, independent of the surrounding or supporting machine. It is caused by the wheel at the point of the work where the wheel is cutting, even though the axis of the wheel and the headstock and footstock may remain perfectly rigid. This vibration may be transmitted to the centers, and it may, if the machine is poorly designed, be transmitted to the heads and finally to the entire machine. *Vibrations may show on the work when there is absolutely no vibration of any part or parts of the machine.*

Vibration of the *work* is never shown by spirals, mottles or spots; but always by lines parallel to the axis. Work may be vibrated by the wheel cut, no matter how large or short it may be. In case of heavy work the vibration is transmitted to the center points, and the number of vibrations per rotation of work is affected by them. This is where the rigid steady rest comes in; it serves to connect the heavy work to the entire table along *its entire length, like resting it on an anvil.*

Long, light work is easy to hold steady while grinding; but heavy, "stiff" work is the most difficult to grind rapidly without chatters; therefore it should always be supported by the best and the most steady rests, because of the weakness of all center points. We need steady rests with slim work, because it is more slender than the center points and vibrates in spite of them. We need steady rests with heavy, "stiff" work, because center points are often not heavy enough to hold it steady.

To assist rapid grinding the center holes in the work should be as large as practicable, in order that contact may be on as large a surface of the center as possible. I am often told by grinders that they have no use for steady-rests on heavy work and that they have no trouble with chatters at high speed of work and fine wheels. If all such were to grind with a wide wheel face and produce more work per minute, they would discover that as the product is increased the necessity for changes in handling would increase. It is all very nice to settle upon a method that will produce good work to-day; but we are not supposed to reach that point where we can be satisfied with our product, but must *continually increase* it. The history of chattering shows that it has been common to all types and makes of machines when the conditions were right and that it has increased in proportion to the increase in product; that it has been overcome by changes in wheels, adoption of steady-rests and reduction of work speed, and that these things have produced similar results in all types and makes of machines.

The later and heavier grinding machines are arranged to rotate the work through gearing, and many who are not familiar with the facts have supposed that vibration of the work was caused by the tooth action of the gears. If this were the fact it would be impossible to change the pitch of the lines by a change of wheel, change of cut and change of speed. It would also be still more impossible to grind without marks without steady-rests at any and all speeds by selecting both wheel and work. Another point in this connection is this: the gear which drives the work is loose upon a heavy fixed stud, while the center upon which the work rotates is fixed in this heavy stud and this center does not rotate. With lathes, as we know, the conditions are the reverse. The gear, spindle and center are one, revolving in an oil bearing, and if there be motion the work must follow it.

There have been much time and money spent on foundations for grinding machines, when the cause of trouble was *vibration of the work itself independent of the machine and its resting points.*

When work shows a mottled or mottled spiral surface, the cause may be vibration of any part of the machine caused by the motion of the wheel. The jar of a heavy belt joint or an unbalanced wheel.

A well designed and constructed machine, however, should be so rigid and self-contained that the axis of the wheel and work will *remain in constant relation whatever the vibration of the machine or floor*, unless in case of a wheel *very much* out of balance; when, if the machine is placed on a solid foundation, there would

in some cases be a *jar* that would cause the axis to change relation enough to show a mottled surface. Another cause of mottled surface is a wheel and spindle too light and running loose in the bearings.

Another cause of mottled spirals is a wheel too hard for the work, or one having an uneven cut on its surface.

The mottled and spiral surface is not known with the more modern *heavy* machines when the best wheels are used.

When work has vibrated enough to show on the surface it has produced an irregular surface on the wheel and the wheel must be trued off before smooth work can be ground, even though the work may be so supported or changed in speed as to prevent further vibration.

We will continue the matter of steady-rests at another time.

A Workman is Known by His Tools.

BY E. R. MARKHAM.

The saying "A workman is known by his tools" is probably as old as "A workman is known by his chips," and, while generally speaking it is true, there are exceptions to it. I have seen many excellent workmen who carried very complete sets of tools kept in excellent condition, and I have seen other men with sets just as complete and in as good condition who were not able to do a fairly good piece of turning in an engine lathe. I have had in my employ men who hadn't as much as a scale or a monkey-wrench, yet who could work all around *some* of the boys who had a *chest full* of the most modern tools. That is, they could for about three weeks out of the month; the other week they were either drunk or getting over it. They had sense enough to keep away from the shop, and the evening before they were ready to come to work they would come sneaking around to the house to see if they could "come in to-morrow morning," promising all sorts of things if they were given just one more chance, and up to a limit this class generally succeed in getting the chance.

Now, I know every hard-headed employer says "none of that sort in mine." I have said it many times, but that tale of penitence, full of good promises—which we knew meant nothing—has seldom failed to gain its point, especially as we have known that it would bother us considerably to find a man who would do as much good work in four weeks as this one would do in three.

I do not wish to be understood as advocating the employment of this class of men, neither do I wish to convey the impression that "bums" are the best workmen; they are not. A man whose brain is confused by excess of liquor is not as valuable a man as he might have been had he left the "stuff" alone. But it is an unfortunate fact that many bright workmen have been the victims of drink, and as they have been, as a rule, roving fellows, they have picked up various ways of doing work that have made them valuable men to have around when they were themselves.

The question naturally arises: How could these fellows with no tools, or at least but a few, do good work where it is necessary to work to fine measurements? They cannot work by guess or to their fingers, as a woman measures cloth, but they can borrow from the "boss" or from some good natured workman who takes pity on them. I remember once working near a fellow who belonged to this class, spoken of as "good men, only they drink." This unfortunate had, at the time I first met him, a 6-inch scale, a monkey-wrench and a hammer. I have reason to know that he did high-grade work, but after two or three of his "periodical" drunks he was discharged. A year or so after this I was working in another shop as toolmaker, when in walked "Frank," looking for a job, and as they needed a good toolmaker right away he was set to work. When he reported for work the next morning the foreman asked him where his tool chest was. He very reluctantly acknowledged that he hadn't any tool chest, neither had he any tools to put in one if he had such a piece of furniture. The foreman asked him how he expected to do their work without tools. His answer was, "Ed has got tools enough for both of us"; by Ed he meant me. The foreman told me he guessed he had got a blank this time, a toolmaker that hadn't even a scale or a pair of calipers. I told him I was willing to supply the fellow with tools and I thought he would be satisfied with him as a workman while he lasted; but as there was but a few weeks' work to be done, this didn't matter so much.

Well, Frank proved to be a very valuable man, and kept straight till the work he was hired to do was finished. He was then let go. Needless to say, he indulged in his usual drunk. Shortly after this he contracted pneumonia and died; but many times have I thought what an ideal man he might have been had he been temperate.

Another circumstance I recall transpired shortly after I had been placed in charge of work. A young fellow came along with a very plausible story as to his ability, and told me he thought he could, on account of his vast knowledge of mechanical things, be of great use to me. I thought he talked too much about himself, but as I needed men just then to make tools for a new gun we were bringing out, I set him to work.

That afternoon he came to the shop with an expressman, who brought his tool chest. When it was uncrated it looked like a piece of parlor furniture, it was polished so highly. The next morning he spread a piece of velvet on the bench and proceeded to lay his tools out, evidently with the idea of showing them to the other men, and they were a splendid looking set of tools, not a mark or a tarnished spot on them. One of the apprentice boys came to me and said, "That fellow is a peach; I can tell by his tools he's the best man you've got working for you."

Well, it developed that the fellow couldn't do anything; he couldn't even fit a taper; so he had to go. The tools that he prided himself so much on could not hold the job for him.

Of course I realize that these two cases, which are directly contradictory, do not necessarily prove that because a man is a "bum" and has no tools he is a first-class workman, or if he has a fine kit of tools that he is necessarily a "no good." As a rule, a man who is a good workman is a temperate fellow who takes pride in the appearance of his tools as well as in the work he does. And while the tools may show the effects of use, they also show that care has been taken of them. A man who would pile files on his vernier or micrometer would not be careful as to the appearance of his work, and in all probability would be careless as to its quality. So I think that, as a rule, it is safe to say that a workman is known by his tools; not by their number or newness, but by the condition they are kept in.

A few years ago men who were unsteady were tolerated to a greater extent than they are at present. A few years ago everything was not done in such a hurry as it is at the present time. The foreman who knows the peculiarities, the good and the bad points of every man, and who would perhaps tolerate a man who would stay out one week out of four or five under monthly payments, provided he was a valuable man when in the shops, is not allowed to overlook two or three days' absence every week under weekly payments.

The shop is followed more closely than formerly by the office, and as they do not know or care as much about a man's peculiarities as the foreman who knows him personally, will not allow such things to be overlooked, and I guess it is for the best, as the example may serve to make the young man whose habits are not fixed more careful. He will be less liable to become intemperate if he sees such men unable to hold positions, no matter how good they may be as men and workmen.

While the latter part of this article may not appear to bear directly on the heading, yet it is in a manner connected with such fellows as the "Frank" mentioned, because they have few, if any tools. They may at times swear off drinking and stick to it for a time, possibly long enough to get a few tools. And right here they prove the truth of our "text," because as they in a measure become men again they take pride in getting tools. But, alas, they go when the fatal day arrives in which they commence to again take a little.

Clerk—"I want more salary, sir, because I am going to be married." Employer—"But I don't believe in 'unions' raising the price of labor."—*Puck*.

Our Industrial Conditions as Viewed by German Eyes.*

Purchasing power, wealth in raw materials and immigration of workers formed the ground in which the root of American industry could take hold. In order to bring to bud the industrial development, as we had previously done, another incentive was found in protective tariff legislation. While, however, there was built up through the tariff a Chinese wall against imports from Europe, there has been no limitation upon free trade between the States of the Union. On the contrary, inland commerce was favored by good means of transportation—the Great Lakes, the rivers (of which more than 29,000 kilometers are navigable), the coast shipping, and pre-eminently the railways, whose development has greatly accelerated industry and whose freight rates, in consequence of free competition, are lower than in Europe.

Finally, it must be borne in mind that this development has been opposed neither by historical traditions nor by laws for the benefit of labor, which laid heavy loads on employers, and it must be said that nowhere in the world better conditions for the success of industry have been and are present.

On the other hand, America sustains a heavy disadvantage as compared with other lands in the hight of wages. According to the latest statistics before me, the average wage of a skilled workman, in general was in 1901 11.65 marks a day, and in the metal and machinery industry 11.25 marks. Entering into particulars, it is found, for example, that a workman on machine building in 1900 in the State of Massachusetts, earned, on the average, 9.80 marks per day; in England, 1899, 6.30 marks; in Germany, 1898, only 3.75 marks. An iron founder can earn in Massachusetts $4 (16.80 marks) a day; a patternmaker or a blacksmith earns 12.60 to 16.80 marks. It is to be remembered, withal, that the working time in the United States is shorter than in Germany.

Taking into consideration what has been said, American industry encounters two factors: First, an extraordinarily great and rapidly increasing demand, and this makes it necessary to manufacture n uch and quickly; that is, to attain a high degree of efficiency in the plants. The second factor is the high wages, which make it necessary to secure high efficiency from human work; that is, to employ labor to the best possible advantage—indeed, where possible, to dispense with it altogether.

. . . . . .

In general the American workman takes no stock in benevolences and arrangements for his welfare. He wants nothing more than higher wages; everything else he holds to be an improper interference with his personal affairs. In American works therefore the quest for devices of comfort other than washrooms is usually fruitless, and where such things are present they have not had the desired influence on the workmen. The Cash Register Company, in Dayton, Ohio, has in fact done much for its people, and yet controversies and strikes break out there, often without substantial cause, and withal there has been established in these works a standing conciliation bureau to arbitrate differences between the workmen and those over them.

The question will be asked, what happens in America to the workman when he becomes incapacitated for service? He must himself save up for his old age—wages are high enough—or else he will become dependent on charity. For sickness or death there are aid funds in a few works, but these are mostly supported by the workmen themselves, or indeed the unions maintain such benefits for their members. Accountability for accidents leads many employers to insurance companies. Often, however, this responsibility must be enforced by an action at law on the part of the workman, and law suits are so costly in America that the workman agrees with his counsel that if the case is lost the latter shall make no charge, but if won, the proceeds shall be equally divided between them.

Gentlemen, I am entering with some minuteness into labor conditions because when we consider the results of American industry, a large share of it is attributable to the workman. Those familiar with labor affairs in Europe and America oft accentuate the statement that the American workman is more productive than the European. This must especially interest us Germans because many American leading men affirm that the German employee, when he has been for a while in the United States, is to be numbered among the best. Wherein lie the causes for this increase of productivity? Many adduce the climate, which stimulates the nerves and urges people to activity. I have not had opportunity to prove the truth of this assertion. There seems to be justice in the view that the American—thanks to his higher pay—is better fed and that he is expected while at work to abstain from alcohol, even in the form of beer.

The management of employees by those above them exerts an important influence. In an American shop, completely democratic relations prevail. I do not mean to say that there is insubordination; on the contrary, each one knows sufficiently well what office he has to fill and whom he must obey. But the workman has the feeling that he is in no way on a lower social plane than his employer. He knows in many cases that the leading man, or indeed the manager himself, entered the factory as a common workman and he has the consciousness that through zeal and merit he likewise may win a higher place, no limits being imposed on him by birth or schooling. I shall cite as an example only Charles Schwab, the well-known leader of the so-called Steel Trust. Whoever looks into the industrial conditions of America discovers many such cases. Through the possibility of advancement the ambition of the workman is maintained and his feeling of responsibility is awakened.

The merit and efficiency of the American workman, however, encounters a force which casts threatening shadows upon the future—that is to say, the labor unions. These have taken up first, in chief, the task of raising wages and introducing the eight-hour day. "We want as much money as possible for as little work as possible," remarked one of their agitators to me in the heat of conversation.

* Extracts from paper by Paul Moeller before the Union of German Engineers. Translated by E. P. Buffet.

Doing Business With the Government.

"No, sir," said a Philadelphian who supplies the government with necessities of life, "you can't do business with Uncle Samuel in the spirit of a contract; you simply must obey its letter. If you put in specifications amounting to 'steen dollars and 21 cents, and then bill it goods under the contract and the total amounts to the same 'steen dollars and 19 cents, you've got to take it back and make up the other two cents, or you don't do business.

"Let me give you an instance of Uncle Samuel's character for exactness. We were awarded a contract for 1,000 feet of copper wire for League Island. We sent the order to the manufacturers, and they turned in the stuff. In a few days we get a letter from the Island authorities that that wire is only 985 feet long.

"We answer that we knew it, that the copper ingot did not yield any more, and that we have charged them only for 985 feet. Would that do? Not on your tintype.

"They sent us word that if that wire was not brought up to 1,000 feet the lot would be rejected. Then we had to get a permit from the L. A. to send a man down to join on enough to make the demand good, and he went down and did the work.

"In a few days we were notified that the piece he put on made the whole length 1,004 feet. We wrote back that we didn't care for the four feet and Uncle Sam could have it.

"Next morning up comes an order to cut off that four feet or the whole bunch would be rejected. Then we had to get another permit for our man to go down and lop it off, which he did.

"Was it all plain sailing then? I should say not. When he threw the offending excess upon the ground the guard said:

"'Pick that up; that's against the rules.'

"He picked it up, and was about to toss it into the river, when he was stopped in a mandatory way:

"'Here! You do that and you'll get yourself into trouble!'

"So, thinking he'd find a resting place outside of the government preserves, our employee walked to the gate, where he found a sentinel.

"'What have you got there?'

"'A piece of wire.'

"'You can't carry it out without a permit.'

"'All right. I don't want to,' and cast it down.

"'You pick that up,' said the sentinel. 'You can't throw things around here.'

"'But I don't want the d——d thing.'

"'Go back and get a permit!'

"And he really had to do it to get that four feet of wire outside of Uncle Sam's fence. Now, wouldn't that make you tired?"—*Philadelphia Record.*

Letters From Practical Men.

Tools for Reaming Flue-Sheet Holes.

Editor American Machinist:

Some time ago our fellow contributor, Tecumseh Swift, called attention to the fact that to gain information through your columns regarding others' practice, it is only fair to first state one's own method and then ask the others. This seems to me only fair.

My method of making flue-hole reamers and countersinks may interest those who read it and use or make these tools, and it would greatly oblige me to be told what other toolmakers are furnishing for this class of work.

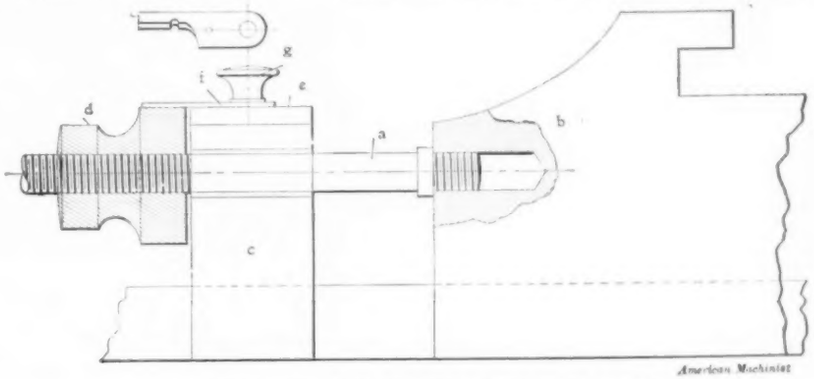
I have been a faithful reader of the AMERICAN MACHINIST for a goodly number of years, but I cannot remember to have read of anyone's idea or practice concerning the cheapest and easiest way to make, sharpen and keep to size the tools used to ream the holes in boiler flue sheets as shown in Fig. 1.

This operation is often carelessly done, with no pretense of either accuracy or finish. When these are required, the tools illustrated have been found efficient. After the holes were punched or drilled, it was formerly our practice to first ream them and then to use a flat two-lipped countersink (a separate tool) to round the edge. The sheet was then turned over and the other edge of hole rounded.

We are now running the countersink with the reamer, making one tool perform the two operations at one stroke. The sheet is then turned over, and the edges are rounded as before. The time is saved in combining the first and second operations.

The reamer and countersink, or rounder, are shells, and are held on the shank and driven as shown in Fig. 2.

The work done by the reamer is all performed by the short bevel, which by successive sharpenings is carried back evenly until worn out, as shown in Fig. 3. Reamers of the rose pattern will not work satisfactorily on the material used for flue sheets, as they present too broad a land, burning on and spoiling the hole. The style shown is about right. The countersink *a*, Fig. 2, has but one cutting edge, and is made very hard. It is easily ground and will last a long time, as its duty is light.



MICROMETER STOP FOR THE LATHE CROSS SLIDE.

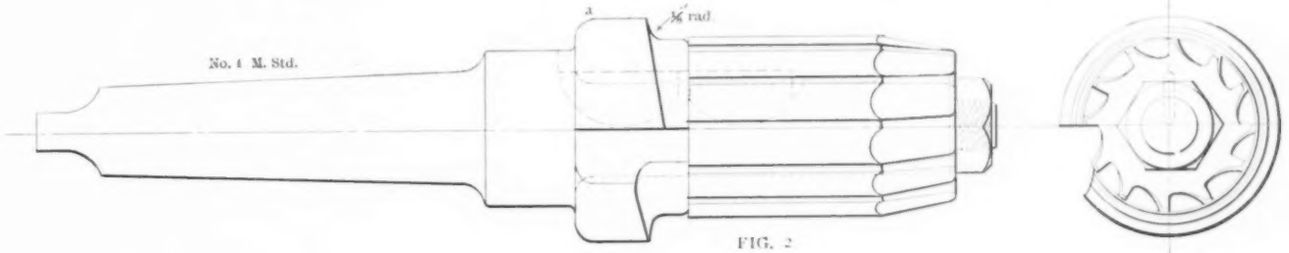


FIG. 2

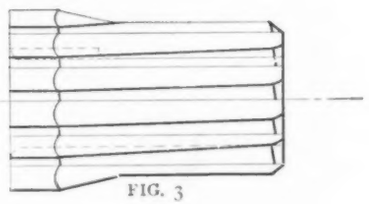


FIG. 3

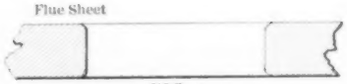


FIG. 1

FLUE HOLE REAMER AND COUNTERSINK.

The manner of making these may be of interest. They are bored, turned and keywayed, the one flute is milled, and lastly the clearance is cut on a lathe rigged with a double snap cam of ⅜ inch elevation, one member being keyed to the lead screw, and the other fast to the side of the carriage. A spring box is provided to keep the cam faces in contact. The lathe is geared to cut the same number of threads per inch as the screw, making a lead of ⅜ inch to one turn of the work.

In locomotive work, where a large number of holes per sheet are required, and where smooth finish, also accuracy of size are very necessary, the advantage of these simple tools is manifest, and the saving of a few seconds thereby per hole means days per year.

H. E. B.

A Micrometer Stop for the Lathe Cross Slide.

Editor American Machinist:

As micrometers of various forms seem to be in style at present, here is another one that I designed about five years ago while employed in a shop in Boston. Almost all modern lathes have a graduated disk on the cross-feed screw, but all I have seen are graduated to give .001 inch movement of the tool-block for each division; this one can be applied to any lathe, and gives .0005 inch for each division, so all that is necessary in using it is to move it as many divisions as one wishes to remove thousandths from the diameter of his work. As will be seen from the sketch, the screw *a* is fitted in the usual stop-screw hole in the tool block *b*, and passes through the stop clamp *c*; it carries on its outer end—threaded 20 per inch—a nut *d* which is graduated, at its large end, in 50 divisions. The graduating was done in an ordinary milling machine dividing head, using an old file ground to a suitable edge for a graduating point, the file being clamped between two collars on the stationary cutter arbor, while the nut was passed back and forth under it. Before graduating, three light lines were scribed around the periphery for guides for the length of

the lines, these guide lines being removed later. The piece *e*, attached to *c* by flat-head screw, is simply a strip to come flush with the top of the nut and carry indicator plate *f*, which may be turned toward front or back and made to answer for inside and outside work. Screw *g* is made with a knurled head; and plate *e* is provided with small pins to fit holes in *f* and locate it correctly.

D. W. R.

Making a Steel Trolley Wheel.

Editor American Machinist:

One of the slickest articles that I have seen made in its entirety of pressed steel is the all-steel trolley wheel being manufactured by us, and of which I send you a sample, which is complete, with the exception of the graphite bushing that is forced in afterwards.

This wheel consists of five pieces, known respectively as the flanges (right and left), the center bearing for contact with the wire, the tube to connect the flanges and the retaining band. All the operations necessary to make these parts are press work, with two exceptions.

The flanges, of which there are two to each wheel, are made of No. 13 United States standard gage, cold rolled, planished steel, and are made in six operations. The blank, after being cut the right size, is drawn into a die that brings it to the shape, as *A*, Fig. 1. The flanges are then marked with the name of the party ordering the wheels, the center hole for the tube is punched in, the burred edge curled and the oil hole in the hub punched; which completes the flanges as at *B*, Fig. 1, when they are ready to assemble.

The center bearing is made of same brand of steel, but No. 10 gage is used instead of No. 13. The blanks for this are cut and a shell *C*, Fig. 2, drawn in a special die. This shell is then trimmed and cut off in one operation in a lathe rigged up for the purpose (we have no turret lathe), the burr cut out in another die, which converts the shell *C* into a steel collar, as *D*. This collar is then stamped or formed in a die, where it is put into shape, as *E*. This finishes the center bearing.

The tube connecting the flanges is made out of the bottom of the center bearing, which, after being recut to the desired blank, undergoes a series of reductions, which converts the blank or disk into a shell or tube, as at *F*; it is then cut off and trimmed in one operation in lathe, as *G*. An oil-hole is then punched in *G*, midway between the two ends and only through one wall of the shell, and connects with the oil-hole in the retaining band.

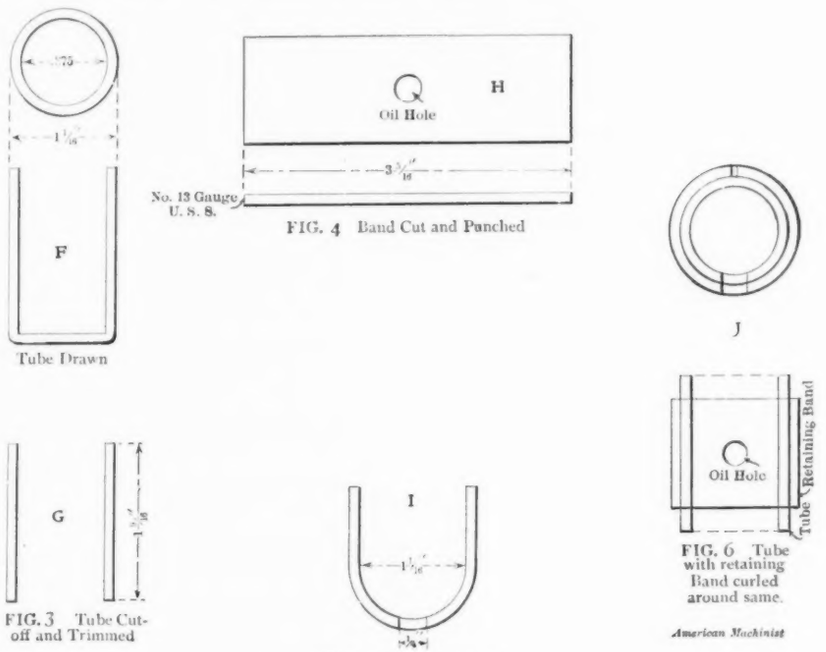


FIG. 3 Tube Cut-off and Trimmed

FIG. 4 Band Cut and Punched

FIG. 5 Band U-ed up

FIG. 6 Tube with retaining Band curled around same.

PARTS OF STEEL TROLLEY WHEEL.

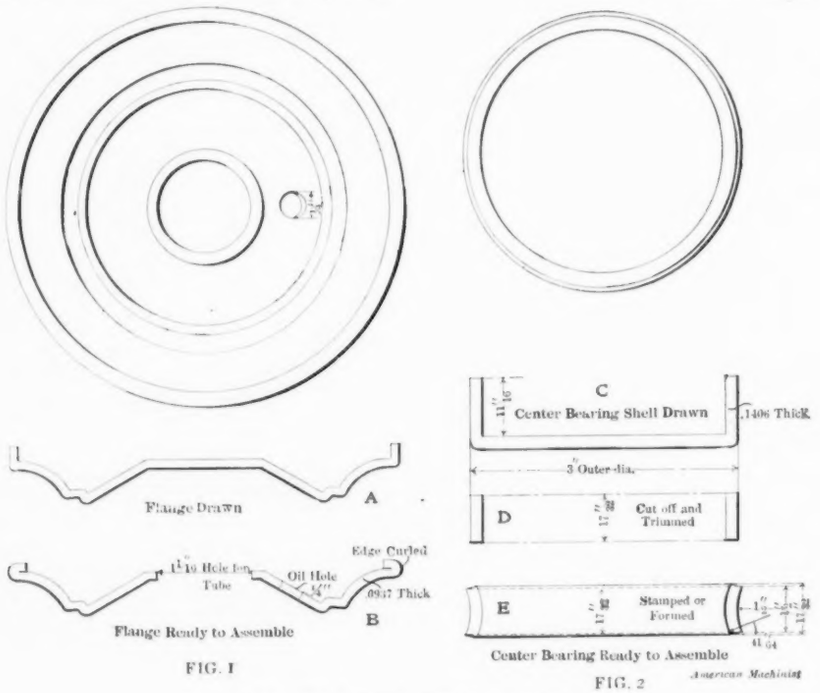


FIG. 1

FIG. 2

MAKING A STEEL TROLLEY WHEEL.

The retaining band *H*, Fig. 4, is made of No. 13 "G," same steel rolled to exact width, so that when it is curled around the tube it will not quite close. The blanks *C* are chopped off in a special die, oil-hole punched as in *H*, V-ed up as *I*, Fig. 5, and closed around the tube as at *J*, Fig. 6. This band is then in position and answers the double purpose of a stiffener for the tube in the heading and a support for each flange in finishing the wheel.

All the parts are now ready to assemble, and the first move is to "tack" all the parts together, which is done in a die, as described. The die consists of a tool-steel disk *A*, Fig. 7, let into a cast-iron bolster *B*, recessed to drive in *A*. The face of the disk *C* is turned the same shape as the outside surface of the flange *D*, so that in placing the flange over, the same is held in position by its form. The disk is recessed to take a hardened tool-steel spreader *E*, which is tapered at the top, as shown. The straight part of this spreader above the taper centers the tube with the retaining band and guides the tube as it is forced through the hole in the flange by the action of the press, and spreads the open end of tube in the recess as at *F*, the diameter and depth of which equalizes the head of the tube projecting through the flange. The punch for this die is the exact counterpart of disk *A*—has the same spreader and recess for the head of the tube, and has two springs fastened to the sides, in which to hold the flange. A pin

is inserted in both die and punch to match and extend through the oil-hole in each flange, and when the die is set these are in line.

The mode of procedure to "tack" the wheels in this operation is as follows: A flange is held up on the punch by the two springs, one of which is shown in Fig. 7. Another flange is placed on the disk in the

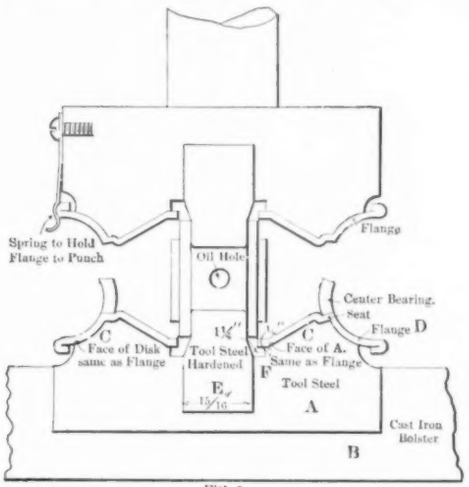
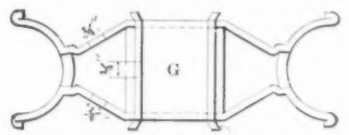
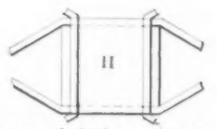


FIG. 7



Apperance of wheel tacked together



Apperance of wheel 1st open to head

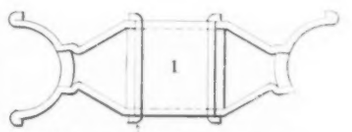


FIG. 8 Apperance of wheel 2nd operation
Ready to ream or broach for graphite

MAKING A STEEL TROLLEY WHEEL.

die; the center bearing is placed so that it will rest in the seat provided for it in the form of the flange; the tube with the retaining band is placed over the straight part of the spreader with the oil-hole in line with the hole in the flange or towards the operator. The downward action of the press forces the tube with the band through the openings in the flanges and spreads each end in such a manner that all the parts are held secure and in place, so that they will not shift or pull apart.

The wheels, after being "tacked," are then headed or curled, which is done in two operations. The first operation starts the curl, as shown at *G*, Fig. 8, at each end, and the second flattens the curled ends down, and fastens the whole wheel together; the head or curl against the flanges, the flanges against the retaining band, and equalizes the hub on each side so that it will be below the outer edge of the flange. The center hole is then reamed or broached to allow a graphite bushing to be forced into it, and the wheel is complete and finished. A. C. R.

A Polishing Mill for Bicycle Spokes

Editor American Machinist:

Herewith I send a sketch of one end of a rumbling or polishing mill designed for polishing bicycle spokes, which is also used for polishing small sheet-metal stampings. I have made and seen a number of mills for polishing spokes, but this does the work the best of any I have seen. It is a little more expensive than the square box pattern, but it does the polishing better, does not bend or tangle the spokes, and is dust tight.

A A are two wrought-iron pipes, 6 inches diameter by 28 inches long, one end fitted with a screw cap, and the other with a loose fitting cast-iron cap or cover, clamped tight by set-screw *I* in yoke *D*. *D* is a hinged cast-iron yoke fastened to *A* by screws *H H*. *J J* are two cast-iron yokes in one casting with holes cast in large enough to receive pipes *A A* without any machining, having a hub in the center to receive the shaft, and secured to the shaft by a set-screw, as shown. *A A* are held in *J* by set-screws *K K K K*. *E* is the shaft bearing (only one is here shown), and *F* is a wood frame on which *E* rests. A tight and a loose pulley are shown at *G*. Fig. 2 is a plan view of *J*.

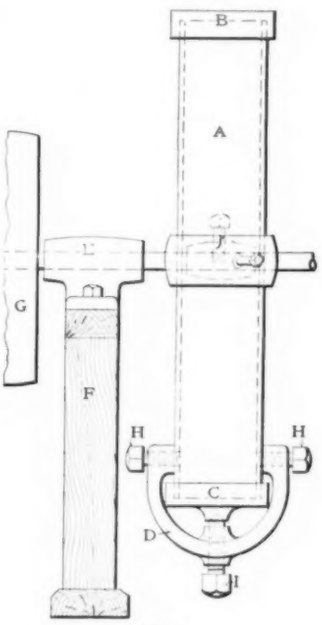


FIG. 1

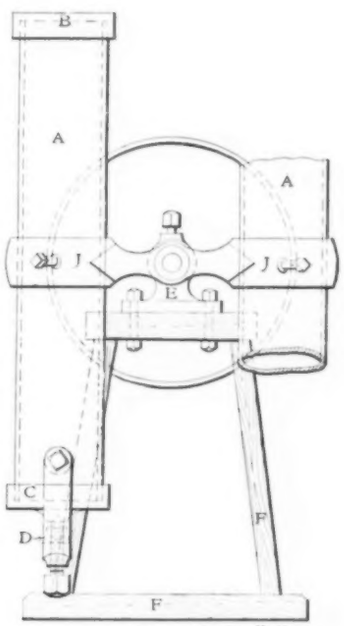


FIG. 3

POLISHING MILL FOR BICYCLE SPOKES.

Fig. 3 shows a pair of tubes, six pairs comprising a mill. Two mills are in use, one working while the other is being filled. A very good polishing mixture is made of scrap leather, brass turnings and oil, which will give a good polish without scratching. POLISHER.

About Soldering Aluminum.

Editor American Machinist:

I have a very good method of soldering aluminum, and I am so surprised at the number of mechanics that I meet who do not understand how to do it, that I am prompted to write about it to the AMERICAN MACHINIST, so that it can be published for the benefit of its many readers. If you have the proper solder and do the work right, you will experience no more trouble than if simply doing a common job of soldering. To make the solder, use the following: Bismuth, 10 parts; zinc, 30 parts, and pure tin, 60 parts. Melt the bismuth and zinc first, then add the tin; pour the whole into molds about a foot long and about the size of a pencil. To do the soldering I use a stick of solder, an old nickel aluminum spoke and a blow torch. Hold the pieces to be soldered in a vise or any convenient place, apply the flame from the torch to them until they are hot enough to melt the solder when it is applied, then scrape the surface to be soldered with a file or scraper. Melt the solder on to each piece and work it around with the spoke; now hold the parts together in front of the flame, move the

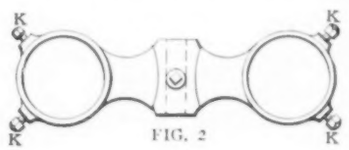


FIG. 2

torch away and let them cool, and the mend will be as strong as if it never was broken. R.

Square-Thread Taps.

Editor American Machinist:

The interesting account which appeared in the AMERICAN MACHINIST some time ago of the making of a very rank pitch bastard tap suggested to me that the design and proportions for square-thread taps shown in the sketch and table would interest your readers. They work well in practice. This may not be new to many, but may aid those who do not know how to so design a set that they will follow each other and each do a fair proportion of the thread cutting.

There seems to be no standard design for square taps, at least I have never been able to find one. This table merely gives the sizes for turning. The milling of the flutes is most important, in that a tap of this description should have a tooth as strong as possible to stand the cut, and also that will provide an abundance of space for the chips. Unlike the chips made by V-thread taps, the nature of the square chip is to crowd, curl up and jam, forcing back and wedging so that one tooth gives way, spoiling both work and tap. The table will answer as well for Acme standard as for square-thread taps.

For the smaller sizes, three to the set is ample, but for larger diameters four, and even five, are necessary. The kind of material to be tapped must be considered. The sizes given seem best for brass and similar metals. If for soft steel or iron, one or two more taps should be added. It is seldom that square-thread taps are required for bottomed holes. When so wanted, another design must be used, the leader on the end being then discarded.

It would be possible to design and make a tap such that a hole could be tapped by one alone, but it would be impracticable for small sizes on account of the excessive length necessary and the spring and change of pitch likely to occur in hardening.

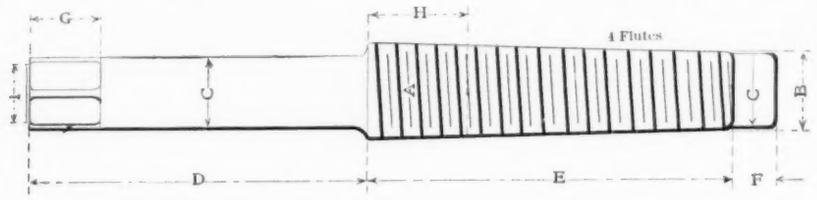
In chasing square-thread taps it is usual to employ a tool, one- or two-thousandths scant, and for the screw one of exact size, insuring a fit. The thread is cut to just clear the dimension *C* for a depth equal to half the pitch. Some believe that a depth of two-thirds or three-fourths of half the pitch the best. This being but a matter of choice, the sizes for diameters *C* and *B* can be adjusted to suit. The entire set is cut the same depth.

The threads should be relieved on top and sides except the last one of the set, which should be relieved on the tapered end only; the straight part acting to finish the thread to size.

The table given allows but little for the last tap to remove. Six sizes are given merely to show how a standard can readily be made. I gladly invite contributions giving the practice of others.

It pays to use the very best steel for this class of tool, and the greatest care should be taken in their making. They should be exact as to diameters, the thread should be cut smooth, and not lean. The milling must be correct. The relieving must be evenly done, by hand, and best with a small flat file. They are more costly to make than V-thread taps, but are great time savers when well made.

For square-thread chasing nothing better has been devised than the Rhodes patent square-thread tool as made by the Pratt & Whitney Company, which has stood the test in our shop for years. H. E. B.



Size		A	B	C	D	E	F	G	H	I
5″	1	33/64″	1″	1″	3 5/8″	3 1/4″	1″	9/16″	5/8″	7/16″
8	2	19/32″	17/32″	1″	3 5/8″	3 1/4″	1″	9/16″	5/8″	7/16″
8	3	5/8″	37/64″	1″	3 5/8″	3 1/4″	1″	9/16″	5/8″	7/16″
3″	1	41/64″	37/64″	37/64″	3 3/4″	3 3/8″	1″	3/4″	3/4″	7/16″
4	2	45/64″	5/8″	37/64″	3 3/4″	3 3/8″	1″	3/4″	3/4″	7/16″
6	3	3/4″	11/16″	37/64″	3 3/4″	3 3/8″	1″	3/4″	3/4″	7/16″
7″	1	3/4″	21/32″	21/32″	4″	3 3/4″	1″	13/16″	7/8″	1/2″
8	2	13/16″	47/64″	21/32″	4″	3 3/4″	1″	13/16″	7/8″	1/2″
4 1/2	3	7/8″	51/64″	21/32″	4″	3 3/4″	1″	13/16″	7/8″	1/2″
1″	1	57/64″	51/64″	51/64″	4 1/2″	4 1/4″	1/2″	15/16″	1″	5/8″
2 1/8″ L	2	61/64″	7/8″	51/64″	4 1/2″	4 1/4″	1/2″	15/16″	1″	5/8″
D'BL	3	1″	15/16″	51/64″	4 1/2″	4 1/4″	1/2″	15/16″	1″	5/8″
	1	61/64″	55/64″	55/64″	4 3/4″	4 3/8″	1/2″	1″	1 1/8″	11/16″
1 1/8	2	1 1/32″	15/16″	55/64″	4 3/4″	4 3/8″	1/2″	1″	1 1/8″	11/16″
3 1/2	3	1 5/64″	1 1/64″	55/64″	4 3/4″	4 3/8″	1/2″	1″	1 1/8″	11/16″
	4	1 1/8″	1 1/16″	55/64″	4 3/4″	4 3/8″	1/2″	1″	1 1/8″	11/16″
	1	1 13/64″	1 1/8″	1 1/8″	5 1/4″	4 5/8″	5/8″	1 1/8″	1 3/8″	7/8″
1 3/8″	2	1 3/32″	1 3/16″	1 1/8″	5 1/4″	4 5/8″	5/8″	1 1/8″	1 3/8″	7/8″
1″ L	3	1 21/64″	1 17/64″	1 1/8″	5 1/4″	4 5/8″	5/8″	1 1/8″	1 3/8″	7/8″
D'BL	4	1 3/8″	1 5/16″	1 1/8″	5 1/4″	4 5/8″	5/8″	1 1/8″	1 3/8″	7/8″

American Machinist

STANDARD SQUARE-THREAD TAPS.

Ink Bottle Holders.

Editor American Machinist:

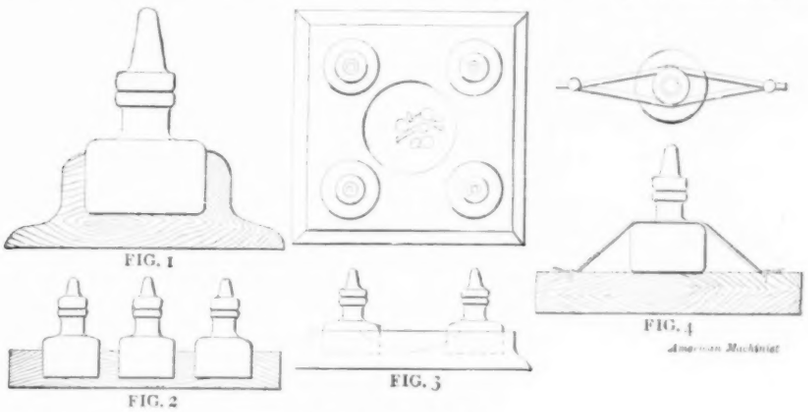
Referring to the article at page 1576, Vol. 26, the holder illustrated, if it is ever required to move the tee-square the entire length of the board, will be in the way, and the only manner in which it can be removed is by taking out the screws, which is quite bothersome, and it is necessary for most draftsmen to remove the ink holders occasionally for this reason; otherwise I think it a very good scheme.

I submit the enclosed sketches, which for some reasons are better, and for some reasons are not as good, although Fig. 4 embodies all the good points and eliminates the bad ones.

Fig. 1, for instance, is a holder I used successfully for two or three years without accident, although it is possible that

the whole thing may be bodily pushed off on to the floor. It is, however, exceedingly simple to make, and, with ordinary care, is a very good holder.

The same may be said of Fig. 3, except that it holds four bottles instead of two, one for black and one for red ink, one for water ink used in section lining wood and one for soda water for marking blueprints. The circular recess in the middle



INK BOTTLE HOLDERS.

makes a very handy receptacle for paper fasteners, thumb tacks, pins, etc. This is a very good scheme where the draftsman is not required to keep ink bottles on his drawing board but is furnished a separate shelf.

Fig. 4 is an exceedingly good impromptu ink bottle holder, it being held down by a flat elastic band, with a thumb tack on each side of the ink bottle. This holder will not tip over and will not push off. I have frequently used it to good advantage.

Fig. 2 illustrates the best method of holding ink bottles I know of. It is simply three holes bored the diameter of the bottle about two-thirds through the drawing board in the upper left-hand corner. I think this will readily appeal to draftsmen in need of a good ink bottle holder. As many holes can be bored, of course, as are necessary. I have three in my board, which I have used to my entire satisfaction for the last two years. The bottles contain red ink, black ink and soda water for marking blueprints. You will recognize this method of holding bottles to be the one universally adopted by schoolrooms, where there is necessarily great danger of upsetting ink bottles and spilling ink.

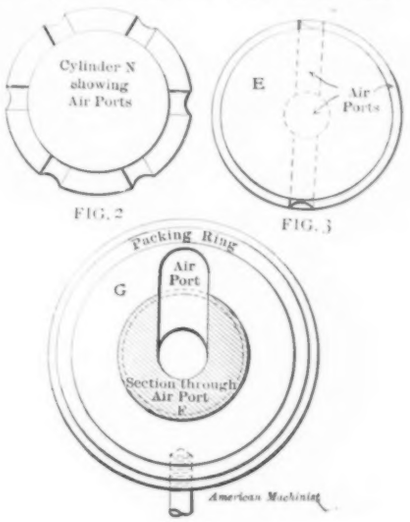
C. H. RAMSEY.

A Special Valveless Pneumatic Hammer.

Editor American Machinist:

The sketch shows a special air hammer which I call the 100-pound swaging hammer, because it works best at 100 pounds air pressure. It is designed for swaging or drawing wire and it is only a part of an entirely automatic machine. At 100 pounds air pressure this hammer will do good work; at less pressure it will not do the work, and at a higher pressure it will hammer the swaging dies to pieces.

Every part of the hammer must be made as nearly perfect as possible; which means more particularly that the round parts must be concentric. *A* is the body or outside shell, of machine steel. It is threaded at one end to receive *F*, and it has eight ¼-inch holes drilled at *T*; these are air outlets. *B* is a tool-steel bushing hardened and ground. *C* is the hammer cylinder or head, and is the piece that strikes the swaging die, the stem of which projects into bushing *D*. It is made from tool-steel and hardened at the striking end about ¾ inch up. This I learned to be the best way, owing to the fact that an all-hard hammer will break in a short time and an all-soft hammer will upset at the end. *S* is an inlet and outlet port; three of these are placed equidistant around, only one being shown in the sketch. *R* also is an inlet and outlet port. The hammer is shown at the end of its out-stroke, exhausting the air from chamber *P* through *R* and *S*, then through outlets *T*. The reverse movement is caused by air pressure in chamber *V* acting against the shoulder on the hammer until ports *S* pass ring *D* into chamber *V*, when they again take air through *S* and *R* into chamber *P*. The pressure in *V* is constant, while the pressure in *P* is intermittent, and of course the pressure in *P* acting on a much larger piston area can always overcome the pressure in chamber *V*.



DETAILS OF VALVELESS PNEUMATIC HAMMER.

The hammer has about ¾ inch stroke owing to the cushioning in *V* and *P*. *D* is a hard brass ring to cut off the air; it is made a neat sliding fit. *N* is a cast-iron cylinder with air ports grooved on outside and end, as shown in Fig. 2. I make this of cast iron because steel and iron make a good combination of sliding surfaces and owing to the fact that the air carries with it particles of dust which get into cylinder *N*, causing it to soon wear, and cast iron is easy and cheap to replace. *E* is a cast-iron port piece (see Fig. 3). *F* is of cast iron or machinery steel, one end threaded and screwed into cylinder *A*, clamping *D*, *N* and *E*. The outer end of *F* is threaded for lock-nut *I*, also bored taper to receive hose attachment *K*. *G* is a valve disk and *U* a pin screwed into it. This pin engages with a cam at the commencement of the swaging, causing the port to open and admit air to hammer and put it in operation with another cam at the finish to move *G* in the opposite direction, cutting off the air supply. Fig. 4 shows packing rings in *G* and a section through the port in *F*.

By starting at *F* and following the dotted line the reader will better understand the course of the air until it reaches chamber *V*.

G. D.

Some American Tool Building Methods.

Editor American Machinist:

Seeing in a recent number of the AMERICAN MACHINIST a very interesting article concerning the production and use of

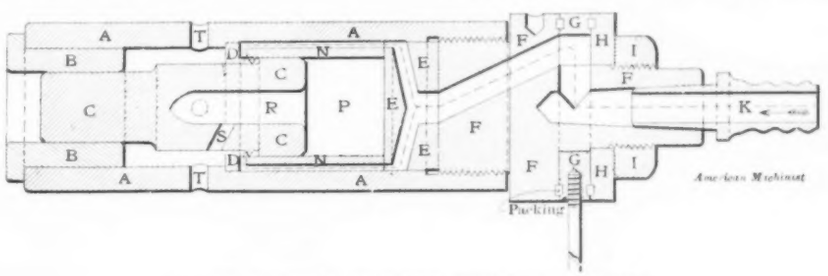


FIG. 1. A SPECIAL VALVELESS PNEUMATIC HAMMER.

cheap lathes in Halifax, England, I am reminded of some lathe building that came under my own observation here in America.

I was working for a small tool concern that ha' contracted to furnish 100 12-inch toolroom lathes. Being a stranger, and

not having had much experience at such work, I did not have opportunity to do the best work, but I had some that was extremely interesting and a splendid opportunity to observe as the work progressed.

The beds were made on a long planer, six or eight at a time, and the way they turned out lathe beds was a surprise. It reminded me somewhat of the way country people turn out pork sausages, both as to rapidity of production and uniformity (?) of product.

The tailstock bases were planed so that they would touch the form in one or two places, after which the "boys" were to "scrape them in"; and as I was one of the "boys," the snap is still fresh in my memory.

The foreman came along one day when we were scraping, and, in language quite unfit for publication, told us that the amount we were adding to the cost of those tail-tock bases was enough to drive him to drink; in answer to which, one of the boys told him that if he would undertake to scrape one to a fit, it would certainly drive him to work, which would be much more unusual.

The spindles and accompanying parts were nicely made, the thrust being taken by a ball bearing; which, however, did not add particularly to the efficiency of the machine, according to my way of thinking, but I mention the ball bearing just merely to indicate the degree of care exercised with regard to some parts and by way of contrast, to make the following appear (if possible) a little more ludicrous.

My first intimation that the lead screws were to be cut in any but the usual way, was when the screw machine operator told me that he was "goin' to cut 'em on the screw machine with a die," but that he didn't know whether it would be any "h——l's roarin' success or not." Naturally, I was watching when the screws came along, and judging from the fact that the error was easily perceptible to the naked eye in 6 inches, as measured by a scale, I concluded that the experiment was not a success by a large majority.

It seemed to me like an outrage for any shop to turn out such work; but it went, just the same.

I should have mentioned before that the price at which these lathes were sold would not admit of first-class work. This being true, it appears that the buyer is largely at fault, and as consumer pays his part of the penalty, it brings us back to the old principle by virtue of which we get only what we pay for.

This case, I presume, was rather extraordinary, and not to be taken as a fair sample of American tool building. The fact that American-made tools can be depended upon to properly account for themselves in actual service is sufficient indication of their quality.

YON YONSON.

Turning on the Milling Machine—A Broach—Compressing Babbitt, Etc.

Editor American Machinist:

Circumstances quite recently permitted me to visit a number of shops in New England and New York, and of the many interesting methods of rapidly producing familiar work which I noted in use I illustrate a few as being of probable interest to my fellow-students of the AMERICAN MACHINIST.

In the shops of the Cochrane-Bly Machine Works, at Rochester, N. Y., Mr. Robert B. Cochrane called my attention to the device shown in Fig. 2, which is employed by them in turning the rolls shown in Fig. 1 to a finish, and to size within .001 inch limit of accuracy. The cutter

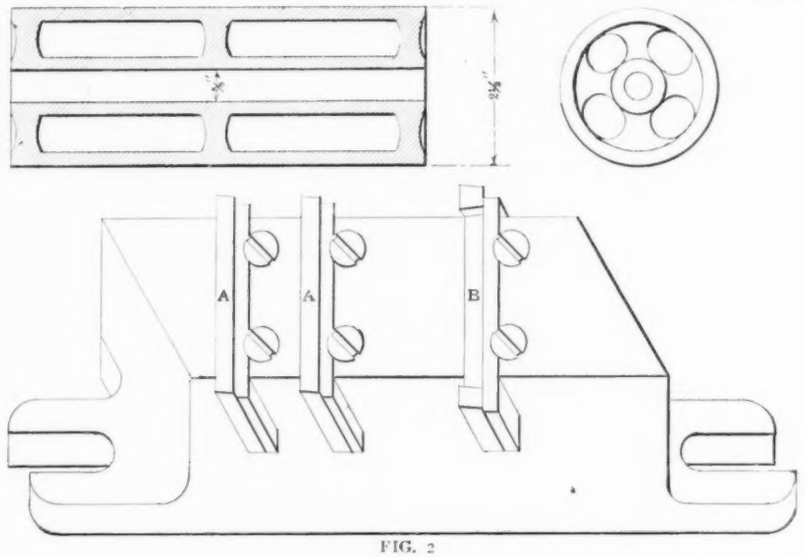


FIG. 2

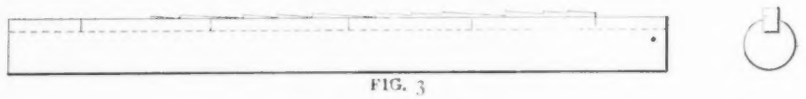


FIG. 3

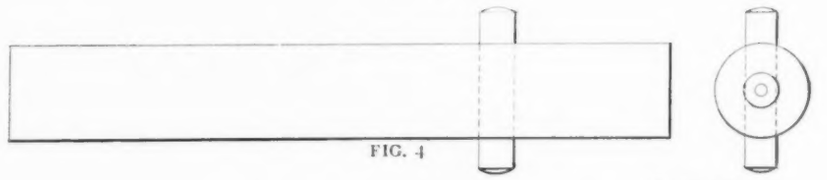


FIG. 4

American Machinist

TURNING ON THE MILLING MACHINE, ETC.

block, Fig. 2, is strapped down on a milling machine table, and the work, which is located on a special arbor, having driving dogs projecting into the holes in the ends, is passed rapidly across it. The roughing cutters *A A* have nicked teeth and the finishing cutter *B*, which has a squaring cutter on each end, brings the cylinder to the exact diameter and length desired. The time for this operation is one and one-half minutes each.

The combined broach and arbor, shown by "Cherry Red" at page 1699, Vol. 26, recalls some of the methods introduced at the works of the Norton Emery Wheel Company by Mr. Maxim, superintendent of their machine shop. A great many small keyseats are cut in their work and a number of them in holes of small diameter. Mr. Maxim employs the built-up broach shown in Fig. 3, for this purpose, in connection with a regular Greenerd arbor press.

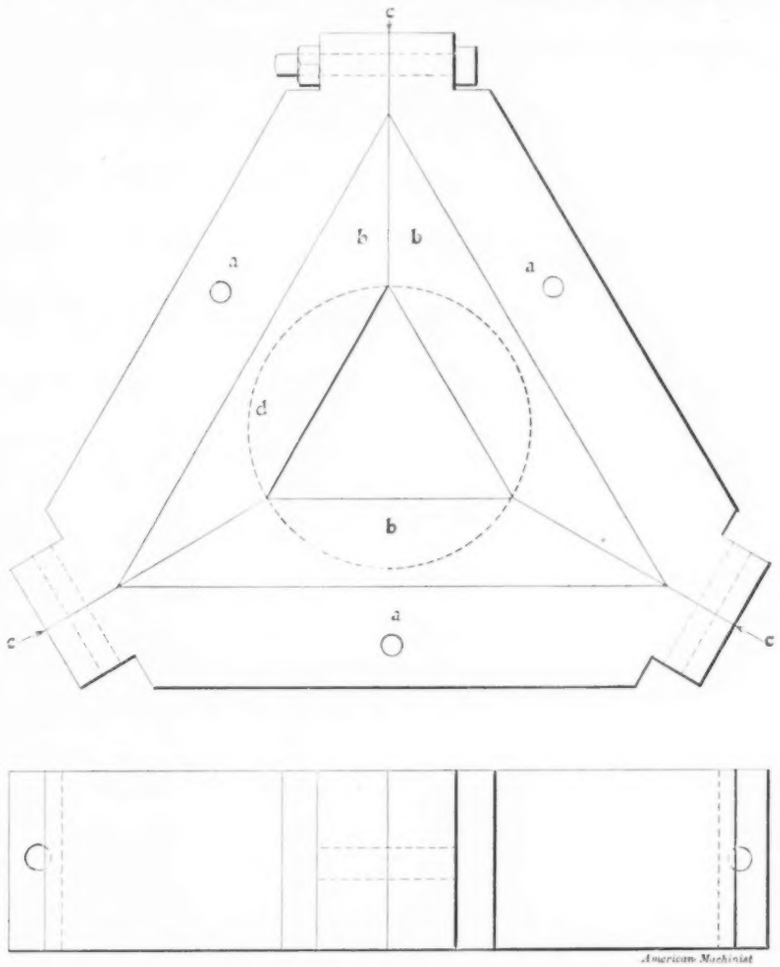
A straight bar the diameter of the hole and having a keyseat its entire length is hardened and ground, and a broach, with tapering face and properly milled teeth, cut into sections to avoid breakage in tempering, is inserted in the keyseat and fastened by small screws. One trip through the job, on the arbor press, does the work.

Under Mr. Maxim's direction a greater range of work is done upon the ordinary column drilling machine than is commonly conceded to that machine. Holes and hubs of small pulleys and similar pieces of work are bored, faced and rounded, and small, cut bevel gears were shown me the blanks for which had been finished entirely by this method, assisted by the liberal equipment of special fixtures furnished. Holes, backs, tooth faces, and recess were machined and duplicated exactly, and in a manner which left nothing to be desired in the way of accuracy or finish. I should say that these gears were probably about eighteen teeth, ten or twelve pitch, with about a ¾-inch hole and ¼-inch keyseat, and their cost, including cutting, was given me as about 4 cents each, exclusive of material.

In Whitcomb's planer shop, at Worcester, I saw a new planer coming out with a

self-contained countershaft on the top of the machine. The superintendent, Mr. Carson, told me a great many very interesting things relating to its manufacture; but what appealed to me most of all was their method of doing away with the squeaking of the belt, in reversing, by the simple expedient of running the belts with the flesh side next the pulleys.

Of course we are all familiar with the compression of babbitt in large bearings by hammering, but it was much of a puzzle to me to guess how it was done in small work, and there may be others in the same class, so I will describe the method used by F. E. Reed Company for compressing the babbitt spindle bearings in their lathes.



A COMMUTATOR CHUCK.

The boxes after pouring are clamped together upon a jig, on the carriage of a lathe, and a truing cut is taken with a boring bar to a size which will leave 1-32 inch to compress. The boring bar is then removed and a bar carrying the compressing tool, Fig. 4, is run through, leaving a nice, smooth hole and enough stock for reaming. The tool is a piece of drill rod, perfectly rounded on each end, and highly polished.

This recalls the means employed by Brown & Sharpe for compressing phosphor bronze for the spindle bearings of internal grinding attachments. This is done by forcing through a reamed hole a succession of smooth and highly polished "broaches" with tapered ends, each of which increases the hole a few thousandths of an inch in size and compresses the metal before its final reaming.

Speaking of babbitt bearings makes me wish that someone would list a few of the machines in which babbitt should *not* be used for bearings. I know one manufacturer who, in all good faith, proposed to use a babbitt bearing merely cast around the spindle, with loose caps and cardboard adjustment, for wear, in a high-class machine tool subject to a speed of several thousand revolutions per minute. It took considerable argument to convince him otherwise, but perhaps this was not so extraordinary, as the same party actually used for several years a cast-iron spindle 1 1-16 inches diameter at its smallest part, running in babbitt bearings at 1,700 revolutions a minute. Finally, so much attention was called to its performance that a change was reluctantly made.

LUCIEN I. YEOMANS.

Madison, Wis.

A Commutator Chuck.

Editor American Machinist:

The accompanying sketch illustrates a commutator chuck which I have used for some time and have found quite satisfactory.

The parts *a a a* and *b b b* are made of any suitable hardwood, such as beech or maple, and are clamped together by bolts at the corners, as shown. The chuck is first assembled with separating pieces of pasteboard or thin wood at the dividing lines *c c c*, and then bolted to the face-plate of a lathe with washers between the chuck and face-plate and bored out, as shown by dotted circle *d* to fit the commutator in hand. The chuck is then removed from the lathe, the corner bolts loosened, the separating pieces taken out, and the commutator put in place and clamped tight. Then the whole is bolted to the face-plate and commutator machined as desired. The pieces *b b b* should be doweled in place to pieces *a a a*.

By having on hand several sets of parts *b b b*, a chuck can be quickly fitted to any commutator within quite a wide range.

G. E. MILES.

Grease and Cups—Cast Iron for Pump Plungers—Shifters and Segments.

Editor American Machinist:

A neat place in which to keep cup grease, and get it out when wanted, is a paint can and press, such as painters use for drop black and other pigments. The grease can be pressed out into the cups with the screw, in much the same manner as in an ordinary grease cup, and there is no possibility of dirt or chips getting into the grease. If a chip gets into a cup it is pretty sure to lodge in the small feed hole and a hot box is the usual result. Speaking of grease cups, they can be used for a pretty good purpose in a machine shop, but for a somewhat different use than they were intended for, namely, as a receptacle for lamp black, red lead or other pigments used by fitters. The pigment is thus always kept clean and free from chips and filings, which are so objectionable; a slight turn will eject the pigment as desired, and the cup can be kept in the tool box without danger of spilling.

The plunger in a pump, which ran constantly, pumping hot water, had to be renewed pretty often, as it wore down rapidly. It was a single-acting, belt-driven, boiler feed pump and ran about forty 5-inch strokes per minute. The plunger was first made of cold rolled shafting, then covered with bronze, and finally made of steel. Neither seemed to give satisfaction, and the packing had to be screwed down constantly to keep it tight, which made the pump run hard, and also rapidly wore away the plunger. It was suggested that cast iron might be a proper material for this plunger, and this was promptly put in. This was several years ago, and the pump has run constantly since without repairs and only one repacking; it runs for months without any attention whatever.

Shifter segments, while not a very essential part of a clutch, still often give

trouble enough to cause much loss of time. A common, and about the worst form of segment is shown at *a*, Fig. 1. In practice it wears as at *b*, especially if the hole for the pin *p* is made somewhat large or wears so. I was once troubled with a case of this kind on a friction clutch somewhat similar to those on lathe countershafts, where the segments stuck so bad that the shifter cone was pretty badly chewed up by the friction levers before it was noticed. The cone stuck to the segments and remained stationary while the shaft and the friction levers kept revolving; the cone was worn so badly that the entire countershaft had to be taken down to re-turn the cone. The cone was splined and a pin was put in the shaft to

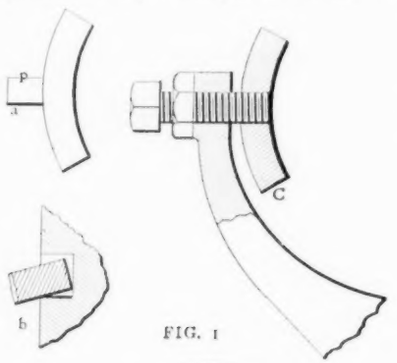


FIG. 1

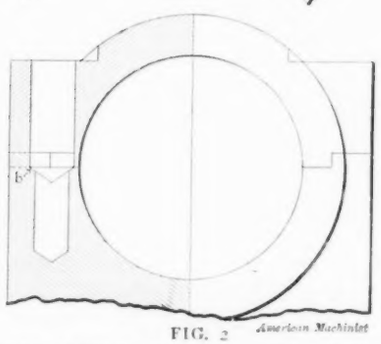


FIG. 2

CLUTCH SHIPPER SEGMENTS—GETTING TAP AND CLEARANCE HOLES CONCENTRIC.

prevent a recurrence of this part of the trouble. I believe a cone of this kind should always be splined to the shaft, as any wearing of the cone surface destroys its shape, which generally accounts for such a clutch failing to remain thrown in. The segments were altered as at *c*, a piece of square steel being bent to shape for the segments, and the fork and segments were tapped for a set-screw; some adjustment was possible and the jam nut held it firmly locked.

To drill and tap holes for cap screws or studs in machine parts, where the limited number of pieces does not warrant expensive jigs, we use a method which ought to be more generally known and followed. In the case of a cap, as shown in Fig. 2, which has been tongued to fit a bed, the cap is left a tight fit and clamped in place on the frame and the body size hole drilled to the point *b*; a bushing to fit this hole and a tap size drill is then inserted and this hole is drilled to its proper depth; this hole is then tapped and a screw inserted and the remaining holes are finished in the same way. This method insures absolutely true work with a minimum of effort, especially where the holes come on the edge of the tongue. Such work as cylinders and heads, flanges, or anything which can be clamped together, can be drilled in this way with a certainty that the holes will come in line. At first a piece of pipe, bicycle tubing, or even sheet stock rolled up, was used for bushings, but tool steel is the best in the end as well the cheapest.

The best, in fact the only proper place for a belt shipper stick is where it can be got at with the least effort or movement, and it certainly ought to stay where it is put without being tied up. How often, however, do we see a shifter stick so placed that the operator must take quite a stroll to get at it, and then take another stroll with it to get the belt shifted. I have always believed that the proper place from which to control the starting or stopping of a lathe is from the carriage, and it could be best controlled by the operator's knee. On a planer or shaper the shifter lever should be definitely located in the side of the housing convenient to the operator. This can readily be done by using a shifter arrangement, as with certain grinder countershafts: a vertical rod with a crank on the top connected to the shifter rod and a handle below for the operator, which becomes a part of the machine, as it should be. I lately saw a planer so arranged, and it was a decided advantage both as regards convenience and appearance; quite different, in fact, from the usual stick in the air located almost anywhere.

GEO. J. MEYER.

A Sizing Boring Tool.

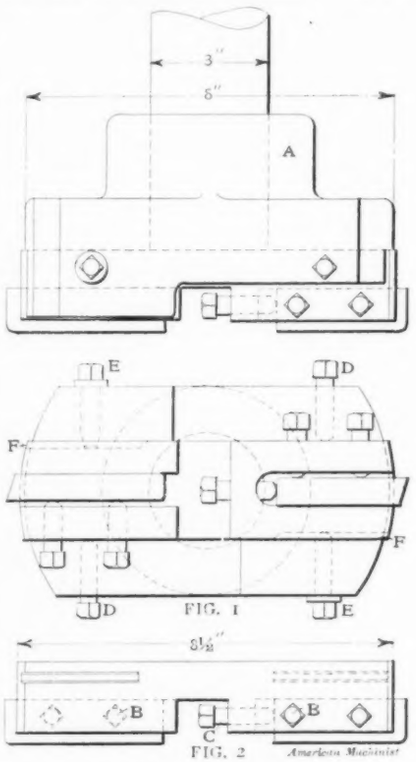
Editor American Machinist:

I send a sketch of a tool made for an 8-foot boring mill for boring cast-iron bushings ranging from 9 to 12 inches inside diameter. It was originally made for just "sizing" the holes after they had been roughed out with a tool in the usual way, as trouble was experienced in keeping the holes parallel and all of the same size, but after the first trial of this tool it was found to be a good thing for roughing as well as for finishing, and now it is used on almost all work within its limits.

The stem is fitted in the place of the regular tool-holder. The casting or head *A*, Fig. 1, is held to the stem by a key and set-screws not shown. The tools or cutters which are of 1¼x⅝-inch steel are held in the tool-holder, Fig. 2, by set-screws *B B* and adjusted to size by screw *C*.

The tool-holder is first held as in Fig. 1 by set-screws *D D*, and a roughing cut about 1-32 inch under the finish size is taken. This tool-holder—the rougher—is then removed and replaced by one with the cutters set to the finishing size. This finishing tool-holder is not locked tightly as was the rougher, but is held in position by pivot point screws *E E*, they being fitted in grooves *F F* in such a way as to allow the tool-holder to slide and so adjust itself central with the work. When a bad hole is to be bored and it seems advisable to take more than two cuts, the roughing tool-holder after the first cut may be used as a single end cutter, providing the vertical slide has been set parallel with the cross-rail.

This holder was made only 18 inches over all, which was long enough for the smallest holes, while the longer bushings were large enough in the hole to allow the tool carrier itself to enter; thus the



A SIZING BORING TOOL.

hold was kept as short and stiff as possible; and now smooth, straight holes all of the same size are quickly and easily bored.

WILFRID J. THOMPSON.

Handling Steady-Rest Work.

Editor American Machinist:

Having noticed, at pages 1260 and 1698, Vol. 26, two articles concerning hold-back clamps for use on lathe work held on the live center and in the steady rest, I wish to bring to notice still another form of clamp which is, I think, superior to any yet mentioned.

In the first article referred to is mentioned, among other things, the use of a belt lacing, or a strap of some kind, with which the work with dog attached can be secured to the face-plate. Such no doubt would accomplish the purpose after a fashion if no other means were at hand, but there would always be danger of the knot untying, or the leather stretching enough to allow the work to slip from the center,

and the possibility of such accidents of course becomes greater with the size and weight of the work handled.

Cy. Press, at page 1698, offers a much better device and one which probably gives satisfaction for light work, though it would fail on heavy jobs.

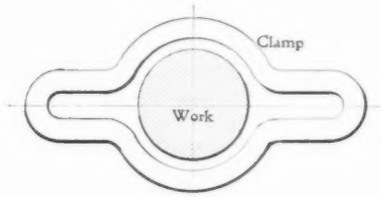


FIG. 1

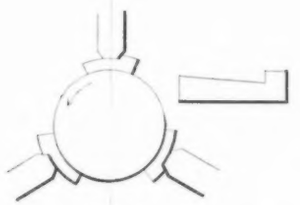


FIG. 2

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HOLDING WORK IN THE STEADY REST.

For nearly a year I used the form of clamp shown in Fig. 1, on all kinds of work up to 16-inch armatures with shafts 3½ inches diameter by about 5 feet long and weighing several hundred pounds. The clamps were made in three sizes from mild steel of square section and shaped as per sketch. The smallest size took all work up to about 1½ inches diameter, while the largest took about 4½ inches. A number of each size were kept in the toolroom and given out on check.

In use the clamp was slipped on the piece first, then the dog was put on and tightened and the work held against the center by two bolts passing through the ends of the clamps and through slots in the face-plate; and if, before tightening the bolts, the clamp was moved slightly one way or another to secure a bearing on the uneven face of the dog, and if the monkey-wrench safety-valve was only in approximately decent working order, there was little or no springing of the work—as was proved by using the indicator. This clamp, though in continued service and used on the work mentioned while running 140 turns per minute for filing and polishing, failed to cause the slightest trouble.

In connection with this work and with Cy. Press' mention of wood jaws for the steady-rest, I would recommend him to try this: Take three pieces of belt leather as wide as the jaws are thick and ½ inch longer than the bearing surface at the ends of the jaws. On one side of each piece of leather cut a notch and then place the three between the jaws and work as indicated in Fig. 2. This will save the time required in frequently changing from wood to metal jaws, and will give perfect satisfaction, as after the first job compresses the strips of leather they can be used continuously for several weeks with little or no wear and without marring the finest surface.

G. R. ANT.

Jig for Drilling a Bronze Bracket.

Editor American Machinist:

At page 1398, Vol. 26, Mr. H. A. Houghton illustrates and describes a jig for drilling a bronze bracket, and makes a special point of the accuracy required on the finished piece of work. As I have been for some years directly connected with the design of small tools and fixtures for the manufacture of interchangeable work, descriptions of methods for dealing with such work are always of considerable interest, but in my opinion Mr. Houghton has very much overestimated the degree of accuracy of the work which could be produced by the methods which he describes.

After describing the method of holding the bronze bracket in the jig, Mr. Houghton says: "Some toolmakers may suggest that a spring might be placed on bar *A* and made to force the piece in place, thereby doing away with the swing screw, but I will remind them that one ten-thousandth of an inch has been fixed as a limit for inaccuracies of the finished work, and we want to be absolutely certain that the bar carrying the bushing is in its proper place and not sprung."

By referring to Fig. 1 it will be noticed that the particular hole drilled by the bush in bar *A*, as well as some of the other holes, is afterwards tapped, and it would be interesting to know how this was accomplished, so as to insure the thread being concentric with the hole previously drilled within a limit of one ten-thousandth of an inch, as there seems to have been no provision made for performing this operation in the jig.

Another very noticeable feature in connection with the jig described is that the bushings are all firmly fixed in the jig, and only one bush seems to be used for each hole, which would suggest that the holes were all simply drilled, no provision having been made for finish boring or reaming to obtain accuracy. It would be necessary to have a clearance of at least one ten-thousandth of an inch between the diameter of the drill and the hole in the bushing, otherwise the slightest heat in the drill would cause it to seize in the bush.

Mr. Houghton admits that with all the precautions taken to insure the jigs being made absolutely accurate, it was found that there was an error in the templet of over one ten-thousandth of an inch, and *"that it was considered impossible to do any better."*

If it was impossible to make a templet which was within the limit of accuracy after spending "days and even weeks," would it be unreasonable to suppose that the jigs which were made from this templet varied slightly from the templet, and, as there were five jigs, each jig would probably vary slightly from the others, and, further, the work which was produced from these jigs would certainly not be more accurate than the jig in which it was drilled.

I would suggest that to drill work to such fine limits, it would be necessary to adopt an entirely different method, and that the holes would require finish boring and reaming after having been drilled. This does not seem to have been provided for at all.

Mr. Houghton mentions that as the bushings wore, they were removed and replaced. It would seem that there was very little allowance made for wear in the bushings if the work was required within one ten-thousandth of an inch; in fact I think it would be safe to say that this amount might be multiplied by ten, which would probably be nearer the actual variation which would be found in the work produced.

Something might be said regarding the method of producing the templet. The vernier caliper does not lend itself particularly well to taking measurements to less than one ten-thousandth of an inch, but I will not take up the space necessary to go into this matter at this time.

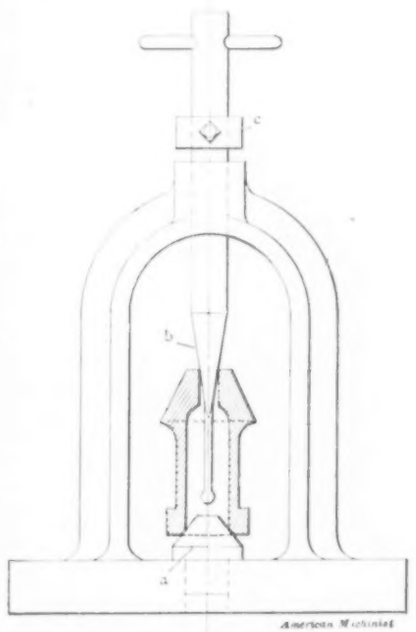
W. A. HILDRETH.

Coventry, England.

Fixture for Opening Spring Chucks When Hardening.

Editor American Machinist:

Spring chucks in our department had always been opened when hardening, by putting a taper arbor by hand into the red-hot chuck, which we then dipped in the water tank. This resulted often in bad work, one of the three jaws bending too much, or the opening being too large. Since using the small fixture shown in the accompanying sketch we have had no



FIXTURE FOR OPENING SPRING CHUCKS.

further difficulty. The evenly heated chuck is put on center *a*, and the pointed arbor *b* pushed into the end, the previously adjusted stop-ring *c* preventing the jaws being spread too far apart. The chuck is handled with common tongs when put in the apparatus and when dipped into water. For heating we use molten lead.

OTTO ECKELT.

Berlin, Germany.

Close Work Without Minuteness.

Editor American Machinist:

It devolves upon me to play Santa Claus in a mild and gentle way to a ten-year-old lady, and when the recent gift-giving season approached she indicated to me that among her most urgent needs was a terrestrial globe. It struck me that the suggestion was a sensible one, for financial if for no other reasons, and accordingly a little working model of our old Earth was bought and conveyed to her in the accustomed way. The globe was only a small one, 8 inches in diameter, and the controlling consideration which led to the selection of that size was that it would be practically on the convenient scale of one inch to a thousand miles. This scale would of course apply not only to the measurement of distances and areas upon the surface of the earth, but also to radial and diametral dimensions, and of course about the first thing thought of is that of relative hights at the surface.

When you get to playing with a globe with the idea of the scale of it in your mind it gives you lots of ground to think over. On this 8-inch globe a mile in hight is a thousandth of an inch. The highest mountains are, say, 5 miles high, or .005 inch on our globe; about the thickness of a single leaf of an ordinary book, and this hight is attained by a more or less gradual slope up from the coast and not in one perpendicular, so that it is really impossible to represent our mountains, our high table lands or even the land at all upon any globe that we can make except, as we do, by lines and colors. The great majority of the people on the earth live less than a mile above the level of the sea, so that if the oceans should rise or the land be depressed on our globe only .001 inch it would represent the drowning of the bulk of the human family. The sea, where I am in the habit of looking upon it, rises and falls in the tides about 5 feet at the utmost, or, say, one-thousandth of a mile, this movement being represented upon our globe by a millionth of an inch, .000001 inch. That must strike one as being rather fine work, especially as the movement is kept practically and unceasingly within this limit year after year through the centuries. The other day we had a fall of snow 6 inches in depth; this would be .0000001 inch on our globe; it is impossible for us to imagine any paper as thin as that. When we consider how comparatively minute are the elevations and depressions on the surfaces of either land or sea, the latter when roughed by storms, the effect of terrestrial surface upon the eye which could look upon it as we look at the 8-inch globe must be that of a highly polished surface. The varnished surface of our 8-inch globe cannot be comparable with the apparently exquisite polish of the surface of the earth when viewed on the same scale.

Regarding everything now from the standpoint of the critical workman, those of us who have peeped into the microscope have some idea of the fineness and accuracy of the workmanship there revealed, whether animal or vegetable or mineral objects are studied. As someone has said in other words, the most penetrating microscope can never show to us things so minute as to reveal or suggest the slightest slighting of the work, or the least lack of skill and precision in the worker. The limit of the field of our knowledge of the immense tells the same story. We must equally admire and wonder at the little and the big.

It's just the same actually in the shop, although too many of us are apt to forget it. Every kind of work that man can do is capable of taxing his powers to the utmost, and in every direction skill and precision reach their limit. The micrometer and its users have been putting on airs of late, but the micrometer and the microscope are not the ultimate tests of fine work as done by human hands. The latest bridge crossing the East River necessitated the doing of things as exacting of human skill—pushed the limits of possible human achievement as close as was ever done in the laboratory of the most patient and inquisitive of "scientific" investigators. The latest steamship is surely, not only as a whole but in many of its details, a greater thing to note in the records of work successfully done than is any lady's watch or any instrument of "precision."

The micrometer as a test of work and a measurer of its perfectness is really applicable to so small a portion of the work that is done even in mechanical lines that it leads naturally, as it has led—or misled, in fact—to the assumption that there is really little good work done, and to the farther error that there are few departments of industry in which what we may call first-class work can be done. By this micrometer idea I was enslaved for years, as have been many machinists, so that I could never do full justice to blacksmiths or molders. I hope I have to some extent become emancipated. I know now that there are done daily in both the trades things the doing of which gives evidence of the most perfectly developed skill and the matured judgment.

No fellow in the shop who is doing honest work need let any other fellow crow over him when it comes to the measuring of the care and the skill that can be put into his line of work as compared with that of the other fellow. I was thinking of this lately when listening to a man who was telling in minute detail about the making of dies for a bolt heading machine—a bulldozer. He was one of those who go into their work whole-heartedly, and while at it think of nothing else. No one except the doer of it would think of the heading of bolts as very fine work, yet this man could tell of so many fine points to look after in doing it as it best can be done that I had to acknowledge not only that he knew his business but that his business required all his knowledge to get all the possibilities out of it.

There is one instrument which is vastly better than the micrometer as a test of work, and that is the clock. The work which stands that test is the best work of the twentieth century, and it is a test almost universal in its application.

TECUMSEH SWIFT.

Shop Systems.

Editor American Machinist:

A number of articles on shop systems have appeared in these pages. Perhaps the effects of some of these systems on the person most affected by them, viz., the workman, and some of his views on the subject may be of interest.

In my capacity of machinist and toolmaker in various Eastern shops, covering a period of some fifteen years, I have had the opportunity to become more or less familiar with and to see the practical effects of various kinds of management, and mismanagement.

All systems in the machine shop are devised, I take it, for the special object of effecting a saving in the operation of the shop by preventing waste, saving time, etc., all of which is very business-like and as it should be. The trouble is that a great many of the systems of to-day are so cumbersome and unwieldy that, like some of the trusts, they use up *more than the saving effected in the cost of keeping them going*, not to mention the dissatisfaction caused to the men and the consequent loss of effectiveness.

Take, for instance, the toolroom system described by P. E. I. at page 1449, Vol. 26. There are in my opinion some good points in this system, such as the card-index record of blueprints and tools; also the checking of gages, templets, etc. However, there is nothing new in this, and the balance of the system is to my mind distinctly bad.

Take, for instance, his example of grinding flat chisels—and I know a shop where this is made compulsory by the removal of all emery wheels to the toolroom. That looks very nice and reasonable on paper, the toolroom attendant keeping chisels, etc., ground ready to hand out to save the man spending ten minutes going to the emery wheel to grind it himself. In practice it works out something like this: In this shop where, according to P. E. I., *everything*, even bolts, clamps, etc., is kept in the toolroom and must be checked or an elaborate form made out (see page

1450, No. 3) and bolts are charged against the man taking them out at 10 cents each. The man will waste three times the time it would take to grind the chisel in awaiting his turn at the window, and my experience of toolroom boys is that hurry is a word unknown to them.

If there were only one man in the shop, this system would be a dandy, but as every man has to go up and get everything that he works with down to the very wrenches and change gears that belong to the machines, and even files are checked, the crowd around that toolroom window must certainly be both interesting and instructive, as there would be ample time to swap yarns and have a comfortable chin, while the suffering toolroom attendant was doing a rapid writing stunt with one hand on the tool list (page 1450, No. 3) while sorting out the required articles to correspond with the other. P. E. I. says he finds it pays to pay the toolroom attendant liberal wages, and I can believe it without much effort.

As for the 10-cent charge against a bolt and other articles used on the company's work, will not the man spend more time than the bolt is worth keeping his eye on it until it gets back in the toolroom and is credited to him again? A firm that cannot trust its employees with even so small an article as that is not going to have any trust from them and will not make by the practice, and you can lay odds to that. Again, when the tool is returned, it must be perfectly clean, or it will not be accepted. A good mechanic takes some pride in his work, tools, etc., and will not turn in a dirty or oily tool, and, even if he did, a toolroom boy at $4 a week is more suited to the work of cleaning it than a man at $18.

Worst of all is the effect of a broken tool. This may, and does, happen to the best and most skilled workman at times through accident. It has happened to me at times when taking the best of care. Who has not had the rush job—wagon-waiting-at-the-door sort? The man takes chances in his hurry to get the work out, and something gets broken. Common sense tells us to let the foreman in charge of the work use his judgment in fixing the blame, if any. But no! According to P. E. I. a document (see No. 2, page 1450) must be made out, addressed to the *manager*, signed by the man doing the damage, then by the foreman in charge of the shop, also by the toolroom attendant (must be a busy boy, all right), who notes the time report is received. The toolroom superintendent notes the extent of damage, and sends the report to the manager, who fixes the amount of the fine, if in his judgment they need the money. In all cases the tools must accompany the report, else the man cannot get his check. Should it happen to be the 60-inch boring mill I suppose they employ a derrick. For a system wouldn't that freeze you?

While on the subject of fines in the shop, let me mention the case of an Eastern shop, employing about 3,500 hands on day and night shift. The man employed by this firm receives a key on going to work on the first day, that corresponds to his number on the time clock. For this he is charged 50 cents. The first week 50 cents is taken from his pay for the death benefit, as there are a good many fatal accidents in this shop, and for every one each man is docked 50 cents for the dead man's benefit. Further, the man is docked 5 cents every week for the accident fund. All this is compulsory. The first week's pay is $1.05 short. A laboring man hired to this firm for $6 per week; he had four days in at the first pay day and received $2.95 for four days' work. It reminds me of something in the Bible to the effect that he that has little even that little shall be taken away.

A lathe hand in this shop has much very heavy work to do—1-inch deep cuts with ⅛-inch feed, and all that sort of thing. All work is piece work. A man broke three lathe tools in succession trying to get a job going, and time limits are cut very close in this model establishment. For breakage a fine of 15 cents and upwards is in force. In this case the man was 45 cents out of pocket, perhaps because the blacksmith got his steel too hot in forging.

A good deal of internal thread cutting is done in this shop. A boring bar and Mushet steel tools are used, each little piece of steel must be taken out on check, and is charged for if broken. The pieces are kept in a box in the toolroom, and the box is shoved out to the man to select from. Sometimes the man would take two or three pieces when the boy wasn't looking, as they were needed to do the work with. I do not endorse this part, but simply state what happpened. One night the boss of the shop and the toolroom man went around, broke the locks and splintered open every tool chest in the place. Every man found having more pieces of Mushet steel than his checks called for was fined 50 cents next day. Nice joint that!

When a man wishes to stay out next day, he leaves notice with the doorkeeper to that effect. If prevented from any cause or neglecting to do this, he is fined $1; if out more than one day, $2. The result is that only the lowest class of men will work there, and thieving is the rule. If a man leaves a scale or caliper on his machine, in a minute it is gone. Not being able to obtain good men, the practice is to hire laborers; train them to one operation and keep them there, allowing them to make $18 a week, less a number of fines. The only object apparently accomplished is that 3,500 jobs are practically shut to respectable mechanics in the vicinity. And why? For what object?

P. E. I. further states that his system, while not *perfect*, "*suits* all our *requirements* and gives *good satisfaction*." Frankly, I do not believe it. I grant that it may be an apparent success from an office point of view, but the office cannot, and does not, see all that goes on in the shop, nor does even the foreman in charge, as he is a pretty busy man in a plant of any size. By this I mean that a lot of discontented men can, and will, dodge a good deal of effort that under different conditions they would be perfectly willing to make. You can, of course, chain a lot of men to their work and station a lot of guards over them as in a penitentiary shop, and make them work to the limit of their endurance. But as the outside shop is not supposed to be run on a system of this kind, does it not follow that a body of men who hold their employer in the light of a just and reasonable man, whose management of his shop shows evidence of a watchfulness on his part over the welfare of his employees, will be hearty and cheerful in their work, and are in a better condition to bring out the best that is in them? Hold each man responsible for the quality of his work, but also let him know that honest effort on his part to simplify and expedite his work is noted and will be credited to him. A firm adopting a course along this line will find it to pay in more ways than one.

I grant such a system as P. E. I. tells us of, might work all right in a shop employing a large number of semi-skilled laborers turning out the rougher grade of simple machinery, cast fittings or malleable iron work, and whose principal thought is the 6 o'clock whistle and pay-day, and who are as a rule careless in the care and handling of tools, etc.

But in this case P. E. I. states that a great deal of the work turned out in his shop is of a very fine order, requiring great care and first-class workmanship, and consequently a high order of workman. This class of men I claim will not work to the best advantage under a restricting system such as this. They feel that they are to be trusted to do whatever they agree to do in the line of a square day's work, whether the boss is around or not, and any system that tends to restrict them to the position of a non-thinking machine, or to assume that they are not capable or willing to take care of the firm's property, tools and equipment will cause them to lose interest in the whole concern and the good men will simply drop out.

A first-class mechanic, as a rule, takes considerable pride and pleasure in his work. He wants the best appliances about him; the advent of the improved machine tool is looked on as an unmixed blessing, as in it he sees the way to turn out the fine job easier, better and quicker.

To hedge this kind of a man (and there are numbers of them about) around with a lot of senseless regulations, hand him out a fixed amount of oil, so many ounces of waste, charge for this and that, fines on everything, no trust, hand over or pay, etc., simply makes him sore and shows him that the management has not the

discernment or experience in handling men to see that he has intelligence enough to use these articles in the proper way without waste or carelessness.

Going further, an elaborate system is originated by the new superintendent, or maybe the pet draftsman, who perhaps never worked in the shop proper at all, and I have known superintendents that come under this head, too.

Requisitions are found to be necessary for everything, and long waits or a journey around the shop to find the foreman (who when found is perhaps busy trying to worry out some practical way to do an intricate job in a hurry) and get him to sign a requisition for a couple of bolts. I once spent nearly half an hour in just such a case trying to get a sheet of emery cloth—my time, ½ hour, 16 cents, besides loss of that much work on the job.

The men see much time wasted, and consequently money, all over the shop in this way; and time is money to them, as they know; in fact it is driven into them pretty thoroughly, for if a man is late five minutes he gets docked fifteen or perhaps thirty minutes, or in some cases he is forced to lose half a day, which maybe he can ill-afford in these times of high-priced and adulterated necessities of life. Do you wonder that it knocks the ambition out of him to do anything out of the usual, devise a new method of doing his work quicker or easier, or to hand out to the foreman the idea that struck him of a tool or fixture to save a lot of time on some job? Then he may sidestep with himself and think how nice it would be if the firm would get the sand out of its eyes and cut out the deadheads and some of the non-producers and the waste of time, money and material in the shop, office and stockrooms and divide only one-fourth among the employees. How nice that would be for a Christmas present! But paradise will be nice, too, no doubt!

Read Osborne's article at page 1455 of the same issue and take a good look at Mr. Minturn. There is a system that seems O. K. and with a practical man at the business end of it. Some men do not use the brains given them to good advantage. Witness Mr. James, who runs his head off, and also his business. Mr. Minturn is not one of that kind; he at once proceeds to convey to his employees the fact that each man is to be credited as well as held responsible for his work and co-operation. This at once gave them a grip, started them thinking and planning for themselves, and as soon as a man improved and became worth more money he got his raise *without asking for it.*

There is nothing that keeps men going better, to my mind, than this little fact. In a shop where the management makes a practice of giving advances to the men unsolicited, when the man unexpectedly finds a dollar or so extra in his envelope on pay day it signifies to him that the firm can see merit and has recognized that he is doing well. Of course he knows he is earning it, or he would not get the advance. At the same time it gives him a jolt, and in nine cases out of ten he will make a resolve to do better yet and get the next raise as soon as possible. A little thing in itself, but the effect in a shop is to immediately put a spur to the men, and the force is in a short time brought to the highest efficiency. The amazing part of it is the meager number of shops that think of doing it.

Another point that system wiseacres do not seem to know: A system like P. E. I. tells us about will tend to keep good men out of a shop employing it. Most mechanics try to find out something about a shop before asking for a job. It was something like this: Charlie meets Bill. Charlie is out of a job. Greets Bill.

"Hello, Bill! Where are you working now?"

"Oh, out at Blank's."

"Any chance of getting in out there?"

"Oh, you can get a job, all right; they are always changing out there. But you wouldn't stand it; you are tagged from the time you start; got to get a requisition to blow your nose, etc., etc. —— of a place! Going to jack up myself Saturday."

The consequence is, Charlie—a good man—doesn't apply.

One of Mr. Minturn's men goes about it differently; he gives the shop a good name, and they add a first-class man to the force. Reputations of shops as well as of people travel far and wide.

A petty little thing that some manufacturers affect is the painted windows. There is a new shop recently put up in my town, that has frosted glass in both sashes, top and bottom, all over the building, with nice, 10-foot plate-glass windows for the office, which is on the second floor, and where light is certainly no more needed than where a man has to make close measurements in the shop. One may conclude then that the superintendent and manager like to see what they are doing. I have worked in a shop of this kind, where the painted windows were thought necessary, and I never noticed that the men worked any harder or steadier because they were denied a glance at the sunshine that God gave man to enjoy and grow strong in. Neither have I noticed any decrease in the output of this same shop in the summer time, when the same windows were open and one could see the forbidden outside world again.

Petty is a good word used for the policy in vogue in many shops where a thirty-minute dinner time is allowed. I refer to the practice of making the men line up during the dinner half hour and lose half or more of it getting their pay and signing receipts. I worked in a shop at one time that disbursed $50,000 every week to their employees. A man came around and simply handed your envelope to you—didn't take two minutes; yet a shop employing fifty hands or so uses the aforesaid system. I have often wondered how the superintendent would like to work 10½ hours and have his lunch cut to ten minutes, and whether he ever went through the process mentioned. Another short-sighted policy in shop practice is very frequently found in shops where piece-work is the rule. I mean the practice of cutting rates as soon as a man begins to hustle up and make more than $3 a day or so. The result is that the man nurses his job, turning out a given quantity and no more. So here we have the work costing the firm more than necessary and the man is prevented from making more than a fixed sum; also the first-class men have to restrict their output to the level of the second raters to hold the price.

Let the price be fixed at a fair standard by actual time of an average man, and make it positively understood that it is fixed and will not be changed as long as the method and tools remain the same. Then the men will work willingly, knowing that they can go ahead and earn as much as they can. The firm will make by the increased production and a larger business, so reducing the cost. The best men will forge ahead, turn out more and earn more than the less expert or less muscular ones, and things in general run smoothly. As a man's trade is all his capital, I say let him get all the dividends he can out of it.

Now I have set down some of the things that I have seen and felt during working hours. Perhaps the literary style is not of the best, but that is not my trade. I am a machinist and may be better with a file than a pen. However, I believe many of our machinist readers will detect some of their own experiences in common with mine in shop life, and will think with me that there are many points in the management of the average shop that could, by the exercise of a little common sense and judgment be improved to the betterment of both employer and employee. Let us do away with the tagged and numbered mechanic. Give us the credit for the possession of some brains at least, and in the average man the change will be at once noticed.

In the shop where all the thinking is supposed to be done by the force in charge a man soon quits bothering his head about things and simply does as he is told. Managers, please do not acquire the Whitworth habit; believe me it is worse than the "library" habit, besides it is not American. Solomon is long dead, and no man is omnipotent, and there is but little use in fooling himself into thinking that he is. Even Dowie has failed.

If our superintendent chance to read this we ask him to step to the door of the shop and look down the lines of the finest mechanics in the world and think a bit. Is our system calculated to bring out the best in these men? Are they contented? Do we have the whistling mechanic or the sullen, dogged, I'll-do-what-I-have-to kind?

How would I act under the present conditions were I employed here as a machinist? Would I be satisfied? Would I be encouraged to use my best efforts? or, in short, would the conditions under the present system warrant me as a first-class mechanic in staying here, or would it be better for me to go to B's shop, where I could very soon make my qualities recognized and rewarded? As time goes on and competition grows keener, this point of getting and keeping the high-grade men under your roof instead of driving them to your rivals will be better recognized.

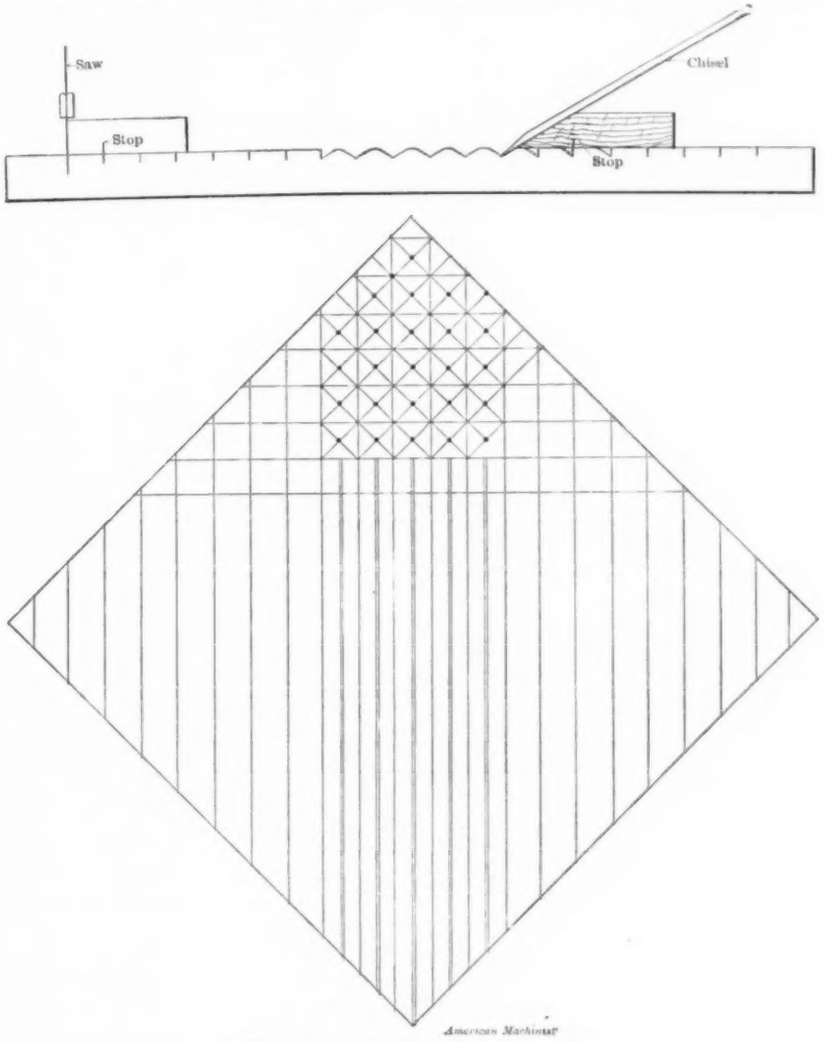
"A MACHINIST."

Cutting a Checkered Plate Pattern.

Editor American Machinist:

I enclose a sketch showing a method used in cutting a checkered floor plate saw is clamped between two bars and can be set any distance below the bars. A saw cut was made diagonally from corner to corner until the bars on the saw contacted as shown, which gave the proper depth. The small pieces of hacksaw blade were then dropped in this saw cut and another made and so on all the way across, thus spacing the distance without any laying out and of course saving that time. The cuts were made both ways, always starting from the longest line to decrease the error, if any.

After all saw cuts were made the angle piece for the chisel was used, the hacksaw stops being used in the saw cuts to properly position the strip to leave a slight flat on top. By using a very sharp, wide chisel ground to a long bevel and holding it against the guide and so the corner will



CUTTING A CHECKERED PLATE PATTERN.

38x38 inches with spaces of ⅝ inch and an angle of incline of 30 degrees. The time required was 8¾ hours.

A piece ¾x3 inches was squared on one edge as a guide for the saw, as shown. In the under side and ⅝ inch from the edge some short pieces of hacksaw blade were driven. The saw used was a 12-inch backsaw of Bishop's make, in which the cut to the bottom, all the stock can be cut out accurately at one cut. In this way a cut can be made diagonally across the grain, leaving the work smooth. Any shape of diamond can obviously be cut by varying the angle across the plate. While it does not always pay to cut these plates, they are often of special size that cannot be had from stock.

J. L. GARD.

Altering Blueprints for Special Construction.

Editor American Machinist:

It sometimes happens that a standard construction is to be modified in some particular case, necessitating alterations on standard blueprints. If these alterations are made with drawing ink they will not only be amply clear for the shop, but the print so altered can be printed from in turn and give a good, clear office record of the alterations on a background faintly showing the regular construction.

Alterations made with soda solutions are not satisfactory for this purpose.

E. D. MACKINTOSH.

[Our correspondent sends us a print with sample alterations in drawing ink and in soda solution, and a second print made from the first, in which the alterations in ink show much more clearly than do those in soda. The effect, however, cannot be reproduced by us in black and write.—Ed.]

A Blank Form.

He was a machinist. He had reason to claim that he was a good one. He had been "up against" an employment bureau in a large works and was mad. He had made out a blank form and *swore* that he would "require" every employer to sign it hereafter before he would go to work.

This was his form:

EMPLOYERS WHO APPLY FOR MY SERVICES MUST FILL OUT THIS BLANK.

How old are you?

White or colored?

Where born?

How long have you been conducting business?

What was your previous occupation?

How much did you make at it?

What education have you?

Can you spell correctly?

Is your credit good?

Do you do good work in your shop or only claim to?

Married or single?

Is your wife red-headed?

Have you any children?

How many?

Does your wife keep hired girls?

How many?

Black or white?

What is the color of their hair or wool?

Does your wife allow you to smoke in the house?

Do you have dandruff?

It seems that there is a movement in England to do away with the "stone" (14 pounds) as a unit of weight, and also with the "hundred weight," which equals 112 pounds. A new standard weight of 50 pounds is to be adopted, and it is hoped that it will take the place of the present very inconvenient units and in that way save a lot of bother in mental and other calculations.

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Arbitration vs. Agreements Between Reasonable Men.

Though it is claimed that compulsory arbitration has worked well in the only country in which it has been tried, it does not seem to meet with favor here, and it is extremely doubtful if the sentiment in favor of it can make headway. There is of course no thought of arbitration between persons who merely propose to enter into business relations. When a man proposes to hire another and they cannot agree as to terms, they never think of submitting their differences to arbitration; they simply "agree to disagree," and that is all there is of it. Arbitration comes in only when disagreements arise after men have been hired and seems to imply that workmen have some sort of claim upon their jobs and that employers have some sort of claim upon the continuous services of their employees. There are plenty on both sides who deny the existence of any such claims, but if such claims do exist they are certainly reciprocal, and the man is inconsistent who maintains that workmen have a right to their jobs but that employers have no right to uninterrupted service or *vice versa*.

In cases where the public interest is involved, as it is in street-car strikes or coal miners' strikes or railroad tie-ups, some form of compulsory artitration would seem to be needed, but when established it should be called by its right name, *i. e.*, a special court to try and to decide labor disputes.

Arbitration as a general remedy for labor disputes is not looked upon with the confidence that it inspired a few years ago. There are cases in which one side or the other is clearly and entirely wrong, and the decision should be in accordance with the fact. But arbitrators have, we believe, never been known to so decide; they always "split the difference" and thereby often do injustice to one side or the other or to both. It is, we think, coming to be generally recognized that the people who are interested in the decision must decide; that they must while guarding their own interests be fair minded enough to perceive that the other man has a right to guard his interests and that only those settlements that are based upon some such substantial agreement between interested parties can be long satisfactory.

A view of these matters which seems to us to be charged with common sense and at the same time an encouraging view was taken by H. T. Newcomb, of Washington, a prominent member of the American Association for the Advancement of Science at its recent St. Louis meeting. Mr. Newcomb, discussing these points, said:

"Obviously the demand is for a temporary remedy for a difficulty which ought ultimately to disappear. With this fact kept carefully in view, it is safe to consider the remedy of arbitration. This has actually but one form. To be arbitration at all it must be wholly voluntary. The term compulsory arbitration is self-contradictory, and however it may be disguised, it really means the creation of a new type of court endowed with authority to make contracts relating to labor services.

"Arbitration—voluntary arbitration—is a term grateful to the ear to which it comes as a substitute for the clash of bitter industrial struggles that it seems ungracious not to commend it without qualification. If men cannot agree, what can be better than to submit their differences to the settlement of a disinterested and impartial third party? If men cannot agree—this qualification begs the entire question. Reasonable men can agree and unreasonable men must become reasonable or be replaced, in industrial affairs, by those who are. One way in which unreasonable men arrange for their own replacement is by getting themselves into situations out of which they cannot be extricated except through the assistance of others.

"The adjustments of industry are too delicate to endure, without injury to all concerned, the frequent interference of the disinterested. A strong personal interest is the element which is most effective in preventing irreparable mistakes. Arbitration may be the smaller of two evils, but no one should fail to recognize it as an evil. Aside from the fact that it leaves the determination of matters of primary industrial importance to persons who will neither gain nor lose by the success or failure of the industry, it is evil in its consequences, because, when there is reason to rely upon its being arranged for, that fact constitutes an incentive to making, and insisting upon, unreasonable demands.

"The easy-going policy which consents to the submission of questions vitally concerning the welfare of an enterprise to persons who have no stake in its success naturally leads to the easy-going method on the part of arbitrators which is expressed by 'splitting the difference' between the conflicting demands of both of the contending parties. This is the almost uniform result of arbitration.

"But if voluntary arbitration is no more than a temporary and rather dangerous makeshift, and compulsory arbitration is utterly to be condemned, what can be done? The answer has been given—men must learn to bargain together reasonably. The remedy ought to appeal to us more because it is a process and not a panacea for all the ills of industrial conflict. That men can learn to settle their disputes over wages without outside aid, and that unions can make and keep collective bargains, has been abundantly proven during the recent industrial experience of the United States. All that is required is that there shall be more of this reasonableness and much less of its opposite. That this will come with the growth and spread of intelligence there need be no doubt."

Shop Systems.

We publish elsewhere in this issue a letter on "Shop Systems," to which letter it may be worth while to call attention. While we do not agree in all points with "A Machinist," his letter is nevertheless interesting as showing the view taken by an intelligent and evidently self-respecting and ambitious mechanic. With all the improvements and changes that are constantly going on, it still remains true that the building of machinery is, after all, a mechanical business, and that mechanics of one kind or another must have more or less to do with it.

With shop managers as well as with legislators, the tendency is, we think, to make too many laws. Your average man who sees people doing things they ought not to do, or which he thinks they ought not to do, immediately bethinks him of a law to stop them, and gets the law enacted if he can. The result is a lot of laws that unnecessarily and unjustly restrict personal freedom and clog human progress.

In a machine shop perhaps a certain thing that is deplorable or wrong occurs. It may never occur again, or if it does the number of such occurrences may be so small as to be utterly negligible and not worth bothering about; yet too often the tendency is to make a new rule to fit this case, and thereby bother, hamper, and perhaps offend a thousand men in the effort to correct the fault of one. All shop rules against swearing, talking except about the work, etc., are worse than useless, and some of the best shops get along without them. If a certain man is offensive with his swearing, or if he seems to think he is employed for his conversational talents, he can be "called down" or dismissed, and that will do a lot more good than a string of rules issued on the shot-gun principle, and which few, if any, employees pay the least attention to, except perhaps to exercise their ingenuity in breaking.

System and order are of course necessary, and as necessary and important in a small shop as in a big one; but it is possible to carry them too far, and while, as we have said, we do not agree with "A Machinist" in all points, we think there is some truth and some sound philosophy in what he says—some things that it would be well for at least a few machine shop proprietors to ponder over a little.

The Indispensable Man.

Every now and again we read of this, that or the other man who is "indispensable" to the success of some great enterprise, and certain men, inflated by a measure of temporary accomplishment, come to regard themselves as not only the king bolts, but the whole running gear of the machine of which they are a part. Hack writers who make it their business to ladle out platitudes to young men urge their readers to "make themselves indispensable" to their employers, and many an otherwise clever youth has had his usefulness destroyed by getting to imagine that he had arrived at the state of indispensability.

It sounds like a Hibernianism, but it is almost true that no man is doing his work so well that somebody could not be found who could do it better, and when a man comes to regard himself as indispensable there are few who would do it so badly. The man who really accomplishes the good work in this world is the one who is always trying to do it better; when he becomes "indispensable" it is time for him to die.—*The Journalist.*

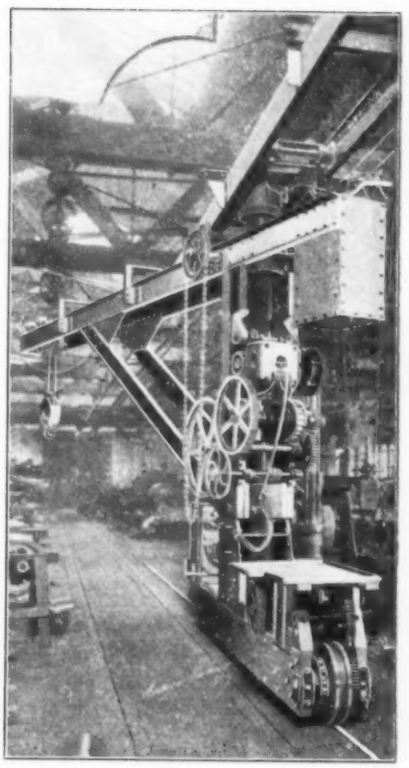
Some New Things.

28-INCH CRANK SHAPER WITH MOTOR DRIVE.

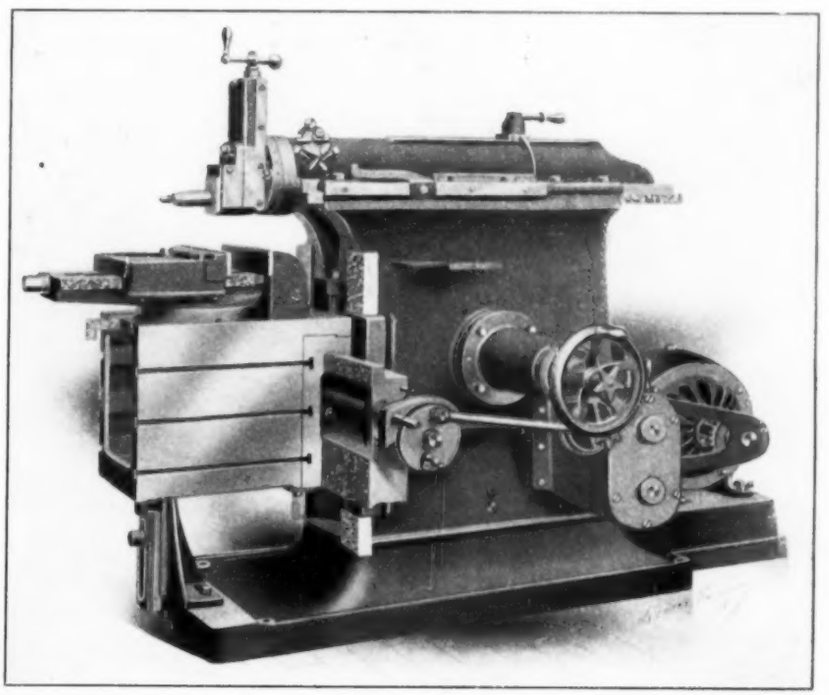
The motor for this tool is carried by an extension at the rear of the base and may be of any type, either constant or variable speed, single or multiple voltage. The drive may be transmitted to the gear box by spur gearing, or by pitch chain, as in the illustration. The speed variator taking the place of the cone pulley consists of six gears disposed on two shafts (one above the other) and giving four speed changes, the back gears of course doubling this number. Where a belt drive from a countershaft is required a plain driving pulley may be mounted on an extension of the upper shaft in the gear box. The shaper is built by the American Tool Works Company, Cincinnati, Ohio.

ELECTRIC TRAVELING JIB CRANE.

The engraving illustrates pretty clearly the utility of this crane. It operates under overhead belts and pulleys, and though traveling the full length of the shop if required, occupies but little floor space, as it moves upon a single rail and is but about 18 inches in width at the base. The supporting rail is carried by a brick and timber foundation, and does not project above the floor sufficiently to interfere with the trucking of material about the shop. Two channels secured, as shown, to the roof chord serve as overhead supports for the crane. A 3 horse-power motor propels the crane bodily along its track at a speed of about 100 feet per minute; a 10 horse-power motor operates the hoist and



ELECTRIC TRAVELING JIB CRANE.



28-INCH CRANK SHAPER WITH MOTOR DRIVE.

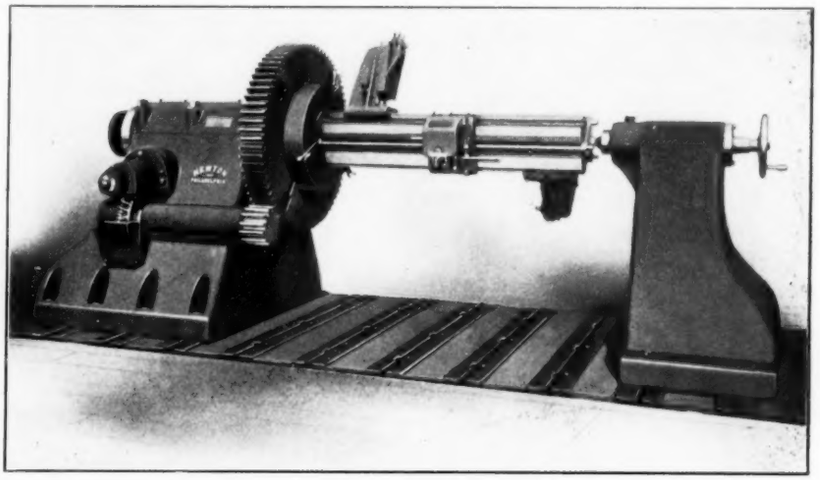
gives a hoisting movement of 15 feet per minute under full load. The trolley is moved on the jib by means of the hand chain at the side, but this seldom requires operating, as the travel of the crane accomplishes the same purpose. The jib swings through a complete circle, enabling the operator to serve machines at either side of the rail; as it is provided with ball and roller bearings, the jib is readily swung by means of the hand-wheel and worm gearing at the rear. An automatic cut-out is provided in the equipment, which makes it impossible to overtravel the hoisting block; this device immediately resets itself the instant the controller is moved to lowering position. This particular crane is regularly built to handle a 2-ton load at a 20-foot radius, but if required may be made to other dimensions and for greater or less capacity. The Case Manufacturing Company, Columbus, Ohio, are the builders.

ELECTRICALLY DRIVEN TRAVERSE SHAPER.

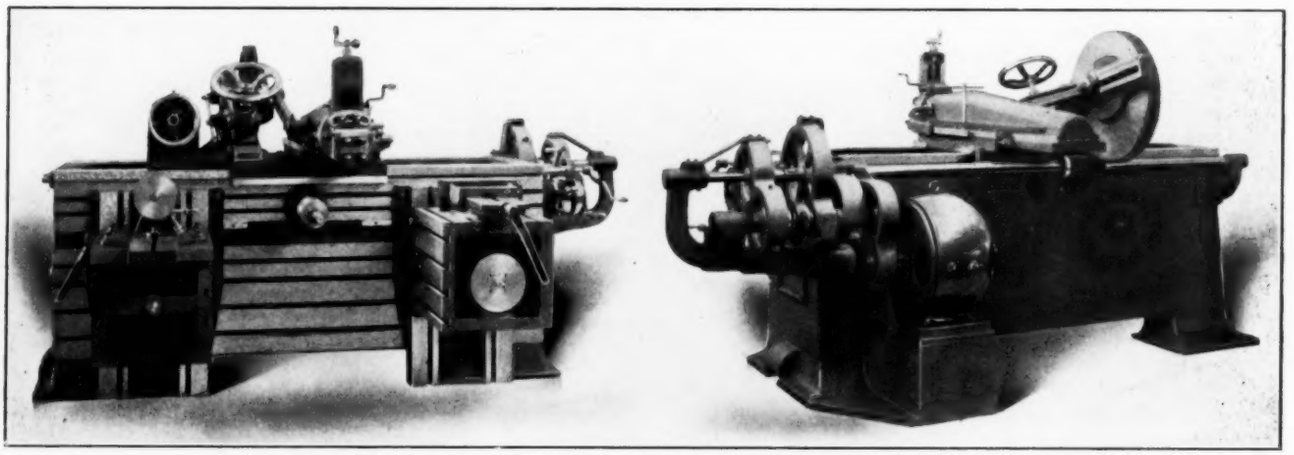
The shaper represented in the half-tone is a 24-inch by 8-foot machine driven by a Crocker-Wheeler 7 horse-power variable-speed motor which is operated on a 4-wire system and mounted on an extension at the rear of the shaper bed. The motor and the shaper driving shafts are connected in the manner illustrated in the rear view, the motor pinion engaging with a gear on an intermediate shaft which carries also two loose gears—of different diameters—meshing with the two gears keyed on the shaper shaft. By means of a clutch placed between the two loose gears and operated by a lever at the front of the machine, either of these gears may be secured to its shaft and made to act as a driver; thus for each speed change derived from the motor two rates of speed may be obtained mechanically. The controller is very conveniently located, it being attached, as shown in the front view, to a bracket at the side of the saddle where it may be easily reached at all times by the operator. This machine is built by the Cincinnati Shaper Company, Cincinnati, Ohio.

PORTABLE BORING BAR.

The accompanying illustration shows the most recent addition to the growing line of portable tools for use in connection with floor plates. It is the design of Mr. John Riddell, mechanical superintendent of the General Electric Company, is the subject of an application for a patent, and was made by the Newton Machine Tool Works, Philadelphia. The leading peculiarity of the design is the form of the boring bar, which has three slide faces for as many tool heads and is, roughly speaking, of triangular section, each side of the triangle being fitted with a tool head. Of these heads the two end ones are for facing, while the middle one is for boring. The form of the bar permits the boring head to pass the facing heads, and the three may thus be in simultaneous operation as the fact that the boring head may pass the others permits it to both begin and finish its cut without interference from them. The feeds are automatic, a feed shaft extending through the main spindle and operating the splined rods which operate the tool heads. In the case of the facing heads, the feed is both along the bar and perpendicular to it, and with all heads the feed may be reversed by the radial levers at the headstock end. The driving is from a motor on the rear side of the machine and out of sight.



PORTABLE BORING BAR.



ELECTRICALLY DRIVEN TRAVERSE SHAPER.

Technical Publications.

"Practical Lessons in Electricity." By L. K. Sager, H. C. Cushing and F. B. Crocker. 226 6½x9½-inch pages with numerous illustrations. The American School of Correspondence, Chicago. Price 70 cents.

This volume is made up of selections from the text books of the American School of Correspondence. The subjects covered are The Elements of Electricity, The Electric Current, Electric Wiring and Storage Batteries. The names of the authors are a sufficient guarantee of the quality of the work, while the price is remarkably low.

"Threads and Thread Cutting." 32 5½x8-inch pages with 28 illustrations. The Derry-Collard Company, New York. Price 25 cents.

This pamphlet is No. 4 of the Series of Practical Papers, of which the previous issues have been noticed in these columns. The present issue contains a large amount of information on its subject, including the making of chasers and their hobs.

"A Calendar of Invention and Discovery." Compiled by J. C. Wait. 4½x6-inch pages. The McGraw Publishing Company, New York. Price $1.

This is a combined diary and record of inventors, inventions and discoveries. The right-hand pages are blank for diary entries, and the left-hand pages contain brief statements of the achievements of inventors and discoverers who were born or who died on the corresponding days. These notes display an astonishing acquaintance with the history of invention and discovery, all fields of effort, all nationalities and all historic time being included. A complete index makes reference easy.

"Points for Buyers and Users of Tool Steel." By George W. Alling, M.E. 224 5½x8-inch pages, with 65 illustrations. David Williams Company, New York. Price, $2.00.

Of the two parts of this book the first treats chiefly of the capabilities and uses of the different grades of steel, while the second relates to its working and manipulation. The author is a thorough believer in good steel, but does not ride this hobby to death, as is shown by the inclusion of a chapter on Places Where Cheap Steel Can be Used to Advantage. He lays special emphasis on the necessity of using proper hardening heats and gives many half-tone illustrations of steel hardened at different heats and then broken to show the resulting grain. Much attention is also given to original defects in steel, their causes, effects and detection. The book can be recommended to toolmakers and others.

It is announced that L. L. Nun, of Telluride, Colo., will establish at Provo Canon, Utah, a school of mechanical and electrical engineering, and that the students in this school will be employed and be under pay while pursuing their studies. We suppose this really means that it is a school for employees, or at least that students must have acquired at least some proficiency at some sort of skilled work.

The editor would like to hear from someone who has definite information as to the gain by the installation and use of a good toolroom system as compared with a poor one or none at all. We all know that there is an advantage in it, but we want to find out how much the advantage comes to in dollars and cents.

Our Chicago correspondent writes:

Trade at Chicago for the past three days has been almost paralyzed by the Iroquois theater disaster. Of perhaps forty business men upon whom I called during that time, representatives of machinery builders, etc., the great majority broached the topic that has been in everyone's mind, and without exception they reported the loss of personal friends and acquaintances. Mr. Wells, who represents here the Babcock & Wilcox Company, lost in the fire his only child Donald, aged twelve years. Donald was one of four boys chaperoned by the mother of two of the other boys. The party of five were all killed.

Personal.

Can anyone give us the present address of Arthur C. Robbins, a toolmaker, who was last heard from in Texas?

Arthur J. Herschmann has opened an office as consulting engineer at 45 Broadway, New York. He will make a specialty of heating, lighting and ventilating plants.

Obituary.

J. P. Allis, who had been for twenty-five years a draftsman with the Potter Press Company, Plainfield, N. J., died in that city January 2, sixty-eight years old.

Clark Fisher, proprietor of the Eagle Anvil Works, Trenton, N. J., died at Flushing, N. Y., December 31, sixty-nine years old. He was a member of the American Society of Mechanical Engineers.

J. Shields Wilson, a mechanical engineer and president of the Wilmington Steamboat Company, died in Philadelphia, January 1, sixty-nine years old. He had been successively connected with the William Cramp & Sons Shipbuilding Company, Neafie & Levy Shipbuilding Company and J. T. Morris & Co.

Sir William Allan, a well-known marine engineer, died in London, December 28, sixty-six years old. He was born in Dundee. Beginning work as an engineer, he served for a time in the British Navy, and then in the merchant service. He became a chief engineer on a Confederate blockade runner in our civil war, in which capacity he had the ill-fortune to be captured. Later he was manager of the Northeastern Marine Engineer Company for fifteen years, and afterwards was connected with the Scotia Engine Works and other large concerns. He was chairman of the Allan Steamship Line, and died a wealthy man. He had published three volumes of poems.

Jeremiah M. Allen, president of the Hartford Steam Boiler Inspection & Insurance Company, died at Hartford, December 29, seventy years old. The life-work of Mr. Allen may be said to have been given to the company of which he was the head, he having held the presidency since 1867. He was interested in general insurance matters before that time. For a number of years he was a lecturer upon insurance topics at Cornell University and at the Worcester Polytechnic Institute, and he was to have been a lecturer this year in the Yale insurance course. He had been a member of the American Society of Mechanical Engineers since 1881.

Calvin Augustus Smith died at East Orange, N. J., December 28, eighty-one years old. He had been quite a noted car builder, perhaps one of the best known in the country. He was one of the leading spirits in the earlier years of the Master Car Builders' Association, and for some time its secretary. He was master car builder for the Erie Railroad for many years, and carried a fine watch, the gift of Jim Fisk and other officials of the road, in recognition of his work in building broad-gage sleeping cars. He was master car builder once for the Standard Oil Company, and at one time had charge of the construction of its big pipe line. He leaves a brother who is ninety-five years old.

John Watson, practically the founder of the village of Ayr, Ontario, and a prominent manufacturer of Canada, died December 15, eighty-three years old. The following particulars are taken from an interesting obituary notice in *Hardware and Metal*, of Montreal and Toronto. Mr. Watson was born in Glasgow, and was apprenticed to a molder when eight years old, serving seven years. He worked as a journeyman seven years more in Scotland, England and Ireland, coming to the United States in 1843. His first shop experience here was at a foundry in Troy, N. Y. He was asked if he could make pots, a familiar job with him, and he said he would try. The foreman said the shop was full of fellows who were trying and he did not want any more. He tramped from New York to Buffalo, working in different shops on the way, and from Buffalo to Hamilton, Canada. Here they asked him if he could make stoves and he promptly answered that he could. While working in Galt, Canada, he formed his plans for starting a foundry of his own, which he accordingly did at Ayr, his raw material being teamed from Hamilton. In the early days when business called him to Hamilton he would, after working for hours, walk to Galt, about 10 miles, and then take the stage to Hamliton, doing this for years until on his return one night, sitting under a tree to rest, he resolved that the business should support a horse. The business grew and prospered, and finally developed into a manufactory of agricultural implements, of which it made and continues to make the greatest variety in the country. He exhibited machines at expositions in many countries, and had received a great number of medals.

Commercial Review.

NEW YORK, Monday, Jan. 4, 1904.

The closing month of the old year in the machinery trade in this vicinity, passed off without leaving anything of particular interest to note, so far as transactions were concerned. Such as were closed were as good as could be expected for the time of the year.

During the holidays many machinery salesmen were in the machinery district. When it comes to getting "a line" on the outlook for the coming year, these men are perhaps as good as any to consult, for

they have been daily thrown in contact with conditions which give them many opportunities to forecast what is likely to occur.

In the interviews which the writer had with several of these salesmen during the past week, perhaps the most significant opinion they expressed was that the hesitancy to make purchases of machinery on a large scale because of the "you don't know what's going to happen" theory, had completely vanished. They said that during the summer months, especially, they were on the verge of closing many trades, but just when they had got the price question settled, and everything looked smooth, the prospective purchaser would tell them that he would wait a little while longer before giving his order, as "nobody knew what was going to happen." This generally had reference to certain adverse developments of the year, which we set forth in this column in our last issue.

After stating that machinery purchases were no longer deferred because of any uncertainty in the general business outlook, our informants said that the basic elements of the machinery situation at the close of the old year, were better than they had been in months. They said that manufacturing enterprises, calling for the installation of machinery, so far as being pushed to completion was concerned, looked brighter than they had in some time.

Machine-tool salesmen thought that the outlook in their line justified optimistic conclusions. Those of them having railroad interests to look after, believed that the new year will not have made much progress before some excellent orders will have been placed. They said that so far as the general machine-tool business outlook was concerned, the surprise would most likely come in the many orders that would regularly come in the market for one and two tools at a time. They said that the outlook for this kind of trade was better than the opening of any new year generally offered.

Among salesmen of power equipment and electrical machinery, the greatest satisfaction was expressed over the probable revival in the building industry, which is expected to assert itself early in the new year. These men brought good news from manufacturing interests, which they said were going ahead with plans, which meant some good orders later on. All of the salesmen seen were glad that 1903 was over, because all of them stated in substance, and one of them said specifically, that it had many "hoodoo" features to it, which they were sure the present year couldn't duplicate if it tried.

An important export order has just been closed with the Manila Construction Company, an American corporation conducting operations in the city of Manila, P. I., for a complete power equipment for the city traction system. The order was secured through Westinghouse, Church, Kerr & Co., and comprises the following machinery: Three 750-kilowatt Westinghouse turbo-generator units, two compound engine exciter units, one motor-driven exciter unit, three 500-kilowatt rotary converters, one 300-kilowatt rotary converters, four 250-kilowatt oil-insulated transformers, complete switchboard, one series booster (this booster is mounted on the extended shaft of one of the rotary converters). The car equipments will comprise ninety double No. 68 C outfits, and ten double No. 56 outfits, using standard Westinghouse controllers. The first turbo-generator unit will be delivered in about nine months.

One of the most interesting developments in the pig-iron situation in the closing week of the old year, was the announcement that two of the largest Southern furnace interests had raised the price of Southern No. 2 foundry from $9.50 to $10.00 at Birmingham, for delivery the first three months of the present year. Beyond that time nothing approaching a uniform price schedule has been made, for the reason that consumers are not willing to talk business. In the meantime the furnaces want to be in a position to meet those who might wish to contract for supplies, and have adopted a tentative price list, ranging from $10.50 to $11.00 for their consideration.

These facts are perhaps chiefly important as indicating how Southern producers view the outlook in the iron and steel industry for the present year, from their standpoint. Apparently they believe an improvement is going to take place, for the longer the period consumers wish to provide for requirements, the higher the price the Southern furnaces demand. They base their opinion largely on the recent course of the pig-iron market, claiming that ever since the recession in values set in, the price of Southern No. 2 foundry never went lower than $9.00 Birmingham, so far as substantial sales were concerned, although it is not denied that there were some small contracts closed at $8.75. They therefore argue that if during the worst periods of the pig-iron depression, prices should find no lower level than those quoted, the improvement in trade which they believe is going to take place during the next twelve months, justifies them in taking the action we have already noted.

What consumers think of their course cannot be stated now. It is said that the furnaces which have raised their price to $10 are well sold up to the end of the first quarter. There is some doubt expressed about this, but if the statement be true, then neither producer nor consumer need care, for the price of anything that cannot be bought or sold, does not concern anybody. But if the report be not true—and to this belief the consensus of opinion inclines—to what extent consumers will now purchase for the first quarter, remains to be seen. Gossip now going on in this direction is all to the effect that they will continue their policy of buying only as their immediate wants demand, and take their chances. In other words, the opinion seems to be that prices are likely to continue at their present level, and some believe that if any change does occur, it will be in their favor. Those who talk this way, do so because they expect that in the next few months Southern furnaces will not have everything their own way, as they have had recently, and that the disparity in prices between their brands and Northern makes, which has gone as high as $2 per ton, will gradually grow less, since cost items of Northern producers are said to be in for a substantial reduction, owing to wages having been cut, and coke and freight rates being lower.

CHICAGO MACHINERY MARKET.

It is true of boilers and engines to a greater extent than many other departments of plant equipment and machinery that December is a peculiarly dull month. Besides the incentive which inventory and the fiscal year showing exert to procrastinate contracts about that time there is the further fact that relatively little power is required in December for immediate or early shipment. Installations not already provided for before this month arrives are generally put off until spring. Were deliveries found to be impossible within three or four months, there might be reason for closing rush work of this kind in December, but except for units so large that that space of time is required to build the same it is now found that makers are in a position to offer reasonable dispatch in deliveries. For boilers or engines of several hundred horse-power, it is easy to secure promises of shipment within ninety days. December, 1903, did not therefore, depart from the typical trade conditions. The builders did not anticipate a rushing trade and were not disappointed in not receiving the same—that is, the majority of them were not.

But some of the makers are prone to make studious comparisons with a year ago. It dismays them that they can now offer product in three months when some little while ago the capacities of their shops were engaged ahead for six or nine months. However the present trade requires shipment within, say, three months, and ability to make that kind of delivery is necessary in order to secure contracts for medium-sized units. The builder whose shops could not respond to that time limit would fare illy in the open market for orders. The present competition is of a character that furbishes up the quality of alertness among the sellers. It is significant, however, that there is a certain spirit of conservatism prevalent. For one of the orders recently placed in the West, where there was some of the usual lively competition, some of the participants voluntarily withdrew before the crucial moment arrived. Their theory was their more remote as well as their immediate

future should be considered, and that if brisk times are coming it may be as well to have a certain shop capacity unengaged so that they could accept orders on a more profitable basis. There is certainly in the trade a hopeful view of business for 1904.

Among recent orders of the Heine Safety Boiler Company was one of three 400 horse-power boilers placed by Joseph Leiter for installation in large coal-mining properties which he is developing near Du-Quoin, Ill. The year 1903 was the best on record for the Chicago office of the Heine company.

The Lorain Steel Company, Lorain, Ohio, are said to have purchased in December from the Allis-Chalmers Company three 3,000 horse-power Corliss engines for the new steel works there in process of erection.

Quotations.

NEW YORK, Monday, Jan. 4, 1904.

New York prices for Northern and Southern irons for nearby delivery are, nominally, as follows:

Northern:	
No. 1 X	$15 25 @ $15 75
No. 2 X	14 75 @ 15 50
No. 2 plain	14 25 @ 15 00
Southern:	
No. 1 Foundry	14 00 @ 14 50
No. 2 Foundry	13 25 @ 13 75
No. 3 Foundry	12 75 @ 13 25
No. 4 Foundry	12 25 @ 12 75

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.40c. upward in carload lots. Soft steel bars, 1.45c. upward.

Tool Steel—Base sizes—Good standard quality, 6¾ @ 7c.; extra grades, 13c. and upward.

Machinery Steel — Base sizes — From store, 1.80c.

Cold Rolled Steel Shafting—2.65c. from store for base sizes.

Copper—Lake Superior ingot, 12⅜ @ 12⅝c.; electrolytic, 12¼ @ 12½c.; casting, 12⅛ @ 12⅜c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 29¼ @ 29¾c.

Pig Lead—4⅜c. for spot.

Spelter—4⅞ @ 5c.

Antimony—Cookson's, 7 @ 7¼c.; Hallett's, 6⅛ @ 6¼c.; other brands, 5⅝ @ 5¾c.

Lard Oil—Prime City, 60 @ 63c., according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

Baldwin Locomotive Works, Philadelphia, Pa. "Record of Recent Construction," No. 44. Illustrated by photographs. 6x9, pp. 31, paper.

"Facts Regarding the Purity of Ice" is the title of a booklet issued by the Patten Vacuum Ice Company, 45 Broadway, New York.

Pittsburg Blue Print Company, Pittsburg, Pa. Pittsburg blueprinting apparatus and supplies. Illustrated. 6x9, pp. 28, paper.

Rand Drill Company, 128 Broadway, New York. Circular No. 10, illustrating the design and showing some practical applications of "Imperial" pneumatic tools.

Steam Carriage Boiler Company, Oswego, N. Y. We have received an illustrated folder showing boilers, steam traps, regulating and reducing valves, damper regulators, safety water columns, etc., made by this company.

National-Acme Manufacturing Company, Cleveland, Ohio. "Milled Screws." This is a catalog and price list of the product manufactured by this company. It is well illustrated, neatly printed and conveniently indexed. 4½x6¾, pp. 31, paper.

Link-Belt Engineering Company, Nicetown, Philadelphia, Pa. Shallow trough belt conveyors, coke and coal crushers. Described and illustrated by photographs showing the design, construction and practical application of the apparatus in representative plants. 6x9, pp. 27, paper.

"A Short Story of William R. Jones" is the title of a booklet we have received from Wyman & Gordon, Worcester, Mass. This is one of a series of brief and interesting biographical sketches of famous engineers, which this company sends out in place of a regular catalog.

Peerless Rubber Manufacturing Company, 16 Warren street, New York. Catalog No. 60, of mechanical rubber goods, including "Rainbow" and other brands of packing, belting, hose, tubing, matting, tiling, etc. Neatly arranged, well illustrated and printed in colors. 6x8¼, pp. 150, paper.

Standard Welding Company, Cleveland, Ohio. Catalog and price list of products, divided into three sections, viz.: Tubing, Seamless Steel Rims, Bicycle Parts and Welding. The catalog is well illustrated throughout, and is profuse with tables and information valuable to bicycle and automobile manufacturers particularly, and to iron and steel workers generally. 3½x6¼, pp. 32, paper.

American Blower Company, Detroit, Mich. Catalog No. 118, second edition, "Mechanical Draft," 7¼x8¾, pp. 60; No. 145, second edition, "The Heating and Ventilation of Manufacturing Establishments," 7x9, pp. 32; No. 155, "Steel Plate Fans," 7x9, pp. 74. These catalogs are all attractively arranged, well illustrated by photographs and drawings, and give much information on the design, construction and practical application of the A B C apparatus they cover.

Manufacturers.

The Buffalo (N. Y.) Lock Company may build a plant at Niagara Falls.

The Taunton (Mass.) Rivet Works have been destroyed or badly damaged by fire.

New buildings of the Star Iron Works at Gowanda, N. Y., are nearly, or quite, completed.

The Raymond-Baldwin Switch Company, South Norwalk, Conn., is moving to New Haven.

The plant of the Lancaster (N. Y.) Malleable Iron Works has been somewhat damaged by fire.

The Macungie Brass & Manufacturing Company, Emaus, Pa., is getting its new plant into shape.

The Otto Gas Engine Works, Philadelphia, are reported to intend to erect a new and larger plant.

A building at Richmond, Va., occupied by J. W. Carr as a brass foundry and shop, has been burned.

The Alpha Portland Cement Company, Easton, Pa., has decided to enlarge its plant at Alpha, N. J.

John H. Binney and W. H. Bach are about to start a factory for the manufacture of mail boxes at Lily Dale, N. Y.

The Boynton Furnace Company, New York city, has let contracts for a new factory building in Jersey City, N. J.

Independence, Kan., is said to be out of the race for the new Missouri Pacific shops, and Atchison's chance is improving.

It is reported that the Union Pacific will enlarge its shops at Omaha, Neb., at an expenditure of something like $250,000.

The Landis Stove Company, Topeka, Kan., is considering the establishment of a plant at Argentine to employ from 80 to 100 men.

It is reported to be the intention of the Baltimore & Ohio Railroad to rebuild at Elyria, O., the car shops destroyed by fire at Lorain.

The Eisenhuth Horseless Vehicle Company, Middletown, Conn., is fitting up a plant for the manufacture of motor cars and motor trucks.

The Kewaunee (Wis.) Casket & Manufacturing Company has just been incorporated and will erect a number of factory buildings this spring.

The machinery plant of A. Streit Machine Company and E. K. Morris & Co.'s storeroom for heavy iron and steel, Cincinnati, O., have been damaged by fire.

The plant of the Henry McShane Manufacturing Company, Baltimore, Md., manufacturer of plumbers' supplies, bells, etc., has been damaged by fire.

Work has begun at Walla Walla, Wash., on the erection of a building which will be used by the Talbert Bros. in the manufacture of a patent disk cultivator.

The Livingston (Mont.) Electric Light Company intends to put in a greatly enlarged plant next summer. The present water power will be doubled.

The Pittsburg (Pa.) Plate Glass Company has made preparations to expend $500,000 in equipping the Elwood, Ind., factory with machinery and appliances.

W. Jessop & Sons, Sheffield, England, steel manufacturers, have been looking for a site in Hamilton, Ont., to build a factory that will employ 2,000 hands.

C. H. Golucke and M. T. Gilbert, Crawfordsville, Ga., are corresponding with manufacturers of handle machinery with a view of putting in a handle plant.

The People's Gas Company, Easton, Pa., chartered several months ago, has secured an option on a tract of land in West Easton and proposes to build a plant.

The Syracuse (N. Y.) Heater Company will vote, January 14, on an increase of its capital stock from $30,000 to $50,000. It is about moving into another plant.

The Corinth (Miss.) Woolen Mills have decided to increase their capital stock from $52,000 to $100,000 in order that the output may be practically doubled.

The Cascaden Manufacturing Company and Waterloo Motor Works, Waterloo, Ia., have been damaged by fire. The latter makes gasoline engines and automobiles.

Charles Kohler, of Dallastown, Pa., and Samuel Tschopp, of Windsorville, have purchased a building at Windsorville, where they will manufacture cigar boxes.

Bonds of $50,000 have been issued by the Hughes Telephone Manufacturing Company, 123 Hanover street, Baltimore, Md., for developing the capacity of the plant.

The old Lamokin car shops at Chester, Pa., have been purchased by the Johnson Railroad Frog & Switch Company, of Chester, Pa., presumably as a site for a foundry.

Dee Allen, president, and W. L. Barth, treasurer of the American Pneumatic Horse Collar Company, have been in Ashland, O., with a view to establishing a factory.

The Home Fire Protection Company, formed by Milwaukee, Wis., men, will manufacture fire extinguishing apparatus. The erection of a factory is contemplated.

Greenlee Bros. & Co., wood-working machinery manufacturers, at 225 West Twelfth street, Chicago, are still said to be considering moving their works to Rockford, Ill.

An effort is being made at Warren, O., to secure the removal to that place of the Fredonia Manufacturing Company, Youngstown, O., manufacturer of wagons and carriages.

The Zastrow Manufacturing Company, Aberdeen, S. D., will construct a factory for the manufacture of a patent combined pitcher and feeder to be attached to threshing machines.

A building at 423 Grand street, Jersey City, N. J., occupied by Levi Alderman as a smelting and refining factory, has been damaged by fire. Valuable machinery was destroyed.

A permit has been granted for a five-story factory building, 120x65 feet, to cost $35,000, for H. Behr & Co., 45 Tiffany place, Brooklyn, N. Y., manufacturers of glue, sandpaper, etc.

The big burned plant at Muskegon, Mich., of the Crescent Manufacturing Company, staves and headings, of Detroit, will be rebuilt next spring and a sawmill will be built in connection.

The Bath Portland Cement Company, recently organized, headed by George W. Roydhouse, president of the Northwestern National Bank, of Philadelphia, will erect a plant near Bath, Pa.

The J. W. Councilor Stamping Works have been organized at Waterloo, Ia. (capital stock, $15,000) and expect to build a factory there. J. A. Councilor, the president, is from Mariette, Mich.

Archibald Henderson, president of the Anniston (Ala.) Bag Manufacturing Company, has made a proposition looking to the formation of a company and establishment of a bag plant at Columbus, Ga.

It is stated in Pittsburgh that building permits have been issued to the Baltimore & Ohio Railroad Company for buildings costing $88,000, to be erected in Glenwood, including a shop to cost $4,400.

Plans are about completed for new shops which the Virginia & Southwestern Railway Company proposes to build in Bristol, Tenn. The company will build its box, freight, flat and passenger cars.

Kitselman Brothers, wire fence manufacturers, Muncie, Ind., are preparing to build an addition to the Royceton factory and to change the boilers, etc., for the use of coal instead of relying on natural gas.

It is stated at Milwaukee, Wis., that the Chicago & Northwestern Railway Company will build large machine shops and a roundhouse next spring on its property at Lake Shore Junction, near Whitefish Bay.

The damage by fire to the foundry of the Glover Machine Works, Marietta, Ga., proves to have been very small. The roof was only slightly damaged and the foundry was running within two days after the fire.

A company has been organized and an automobile factory is being established at Luverne, Minn., by Leischer Brothers and Henry Bierkamp. Men have been in the East to purchase machinery for the plant.

A contract has been made by the American Radiator Company, of Chicago, with the City Council and the Board of Trade, Litchfield, Ill., whereby one of the company's factories will locate there. It will employ 250 men.

There will be blacksmith and machine shops, etc., in connection with the immense plant of the Astoria Light, Heat & Power Company, in Queens County, which is to supply gas to various parts of Greater New York.

It is stated at Sandusky, O., that with an expenditure of $100,000 the Superior (Wis.) Manufacturing Company, of Minneapolis, Minn., and elsewhere, will establish itself on Kelley's Island, open quarries and build docks.

The Novelty Iron Works, of South Allentown, Pa., have bought a site on which they will erect a new plant and will greatly increase their force of seventy-five men. They will also develop their new patent on galvanizing.

Thomas Carlin's Sons Company, foundry and manufacturer of machinery, etc., Allegheny, Pa., has bought property on River avenue, Allegheny, containing buildings, which it is supposed they will use for the purposes of the company.

Mayor Kiley, of Marion, Ind., has received a letter from Stephen D. Demmon, of Chicago, asking for information concerning 100 acres of land on which to locate a factory to employ 500 men and manufacture agricultural implements.

W. W. Wainright, of Connersville, Ind., announces that he has his new shop ready for the execution of orders or contracts of any kind in the line of mechanical engineering, drafting, patternmaking, castings, tool work or special machinery.

The Pioneer Pole & Shaft Company, of Piqua, O., one of the newer combines, is beginning to concentrate plants in Anderson, Ind., where it is the intention to have the largest pole, shaft and wood-bending works in the United States.

A proposed company in which a Mr. Rowland, of Crawfordsville, Ind., is interested thinks of locating a plant there to manufacture a new fuel called "coaleo," the headquarters of which invention seem to be at present in Indianapolis.

The Magnetic Equipment Company, whose agents, Messrs. Lewis and Sterling, have just opened up headquarters in Nashville, Tenn., may locate a branch manufactory there after the main factory at Chicago is built. It will make a car-wheel device.

The Albany (Ind.) Light & Power Company's plant, which supplies electric light, etc., has been badly damaged by a gas explosion. Gas accumulating beneath the floor of the engine-room is thought to have been responsible for the explosion.

It is stated at Kansas City, Mo., that the Manufacturers' Association has received the proposal of J. H. James, of Fort Scott, Kan., who makes window display fixtures and is organizing a stock company with the intention of locating at Kansas City.

The Current Motor & Power Company has been formed at Spokane, Wash., for extensive irrigation purposes and may possibly build a plant to make its own motors. Among those interested is O. L. Hanson, superintendent of the Northern Pacific Irrigation Company.

A new gas-engine plant of the Lambert interest, Anderson, Ind., is just starting up. This means the removing of the gas-engine interest of the Buckeye Manufacturing Company to this new plant. The factory in construction alone is said to have cost over $150,000.

James C. McKee, of Cleveland, O., who is said to control patents used in the manufacture of steel cars, has been in Minneapolis, Minn., to see about establishing shops there. It is understood that the Commercial Club is willing to furnish a site of thirty acres for the plant.

H. H. Pottle, of New York City, has undertaken to finance a recently chartered cotton mill to be built at Marshall, N. C., on the French Broad River. An innovation will be the importation of working people from the crowded tenements of New York city to operate the mill.

The Wentz Engineering Company, Nazareth, Pa., is to construct for the Standard Portland Cement Company, headed by Judge F. H. Aldrich, of Detroit, Mich., a 1,000-barrel plant at Edgewater, 12 miles north of Frankfort, Mich. Power will be taken from the Platte River.

Arrangements are on foot for the establishment of a silk mill, capitalized at $150,000, at Grafton, W. Va. John W. Dawson, who is said to have interests at Reynoldsville, Pa., makes the proposition. It is proposed to organize the West Virginia Silk Manufacturing Company for the purpose.

With the exception of three blast furnaces, the entire plant of the Edgar Thomson Steel Company at Braddock, Pa., was closed down, December 16, for extensive repairs. It was stated that the plant has enough orders booked to keep it in full operation from the first of the year till July.

The International Silver Company, Meriden, Conn., has awarded a contract for enlarging the plating room attached to the flatware department at Factory E. The flatware business has been unusually busy of late years and the prospects are said to be exceedingly good for 1904.

The Round Top Cement Mill, near Hancock, Md., destroyed by fire several years ago, is likely to be rebuilt. It was owned by Robert Bridges and Charles W. Henderson. It is reported the sons of Mr. Henderson have purchased the interest of Mr. Bridges and will organize a new company.

Funk, Lawrence & Co., Chicago bankers, have written to Secretary Ives, of the Rochester, N. Y., Chamber of Commerce, that Rochester is one of the cities under their consideration for the location of a big watch and watch case manufacturing concern, in which it is proposed to consolidate some existing companies.

The management of the Griffin (Ga.) Manufacturing Company, textile goods, proposes completing its electric power plant at High Falls, on the Towaliga River, this year. Power will be furnished to industries in and around Griffin, including several new underwear mills, which, it is said, are to be located there.

The Bingaman-Savage Brass Company, Pittsburg, Pa., has been organized, with $20,000 capital stock, by Charles A. Bingaman, Cornelius N. Savage and N. F. Savage. The company has bought a brass manufacturing plant of the Woodworth-Evans Company, at 434 Second avenue. The capacity will be increased.

New Corporations.

It is stated at Indianapolis that a company has been incorporated to manufacture motor cars and other machinery in Marion, Ind., by Robert J. Hassler, Jr.; J. Arthur Little and I. G. Beise. Among the directors are Charles A. Bookwalter and Fred A. Joss.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 146.
Caliper cat. free. E. G. Smith, Columbia, Pa.
Punches & dies. Wal.M.Wks.,Waltham,Mass.
Stamping Dies. Emmons Collins, Chicago.

J. Gregory, 140 W. 23d st., New York, specialist in small machine designing.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Pattern letters and figures for wood and metal patterns, tablets, etc.; also steel stamps. Knight & Son, Seneca Falls, N. Y.

Wanted—Text books or bound volumes of shop practice course of a correspondence school. Box 3, AMERICAN MACHINIST.

Special machinery for reducing labor and increasing profits, designed and perfected. C. E. Sargent, M. E., 1214 Manhattan, Chicago.

M. Neumayer's Engineers' Handbook of Details and Machinery, $3.50. Write for pamphlet. 243 Southern ave., Cincinnati, and 508 Tenth st., Brooklyn.

Wanted—To build special or experimental machinery; we have expert designers, draftsmen and mechanics; prices low; consultation free. Salem Iron Works, Winston-Salem, N. C.

Manufacturers of automobile parts and accessories of every description, either in rough or finished, kindly send complete catalogs and prices for filing. Alden Sampson Mfg. Co., Pittsfield, Mass.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

Want to furnish men of proved ability, as managers, superintendents or foremen, in the metal-working industries; no charge; also want men to fill such positions. For terms address James Brady, Room J, 20th Floor, 220 Broadway, N. Y. City.

Power Specialist.—Mechanical and electrical generating or transmission systems planned or installed; correct design and the elimination of wastes produce highest results at lowest cost. Irving A. Taylor, M. E., E. E., World Bldg., N. Y. City.

For Rent—Foundry, adjoining machine shop, working full handed; centrally located in Reading, Pa.; suitable for light and heavy castings; good location for jobbing site; foundry castings taken in exchange for rental; established for 70 years. Box 5, AM. MACH.

Talking Machines.—Advertiser has patent on motor for talking machines; simple electric drive; can be run on a battery of dry cells; cheap to build, light in weight; also has original ideas in the matter of spring motors for above machines; good shop organizer; seeks capital to manufacture and experiment; principals only need address. Box 17, AMERICAN MACHINIST.

Draftsman wanted, preferably a young man with a few thousand dollars at his command, to engage in the manufacture of several new machine specialties already introduced and to work up designs of other new and patentable machines now demanded in cement and other manufacture; a substantial and paying business for the right party. Address Box 19, AMERICAN MACHINIST.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Pulitzer Building, 63 Park Row, Borough of Manhattan, New York City, N. Y., on Monday, January 11, 1904, at 12 o'clock noon. Dated, New York city, December 14, 1903.

F. R. LOW, Secretary.

For Sale.

2 H.-P. Webster gas engine; nearly new; perfect condition; $80. E. L. Tyrrell, 36 N. Main st., Waterbury, Conn.

For Sale or Rent—Old-established boiler shop in a city of 45,000 population, with wide adjacent territory. Address S. C. B., care AMERICAN MACHINIST.

For Sale, Cheap—A complete scholarship of mechanical and electrical engineering in the International Correspondence School. Address Box 23, AMERICAN MACHINIST.

For Sale—Four complete sets of patterns with all drawings for large machine tools; will be pleased to correspond with parties wishing to take up a good line. Box 442, AMERICAN MACHINIST.

For Sale—A machine shop in New York city (Manhattan); suitable for special machine building, automobile and general repair work. Established three years. Fully equipped with modern tools, all in first-class shape. Good location. Address R. C. Handloser, M. E., 127 Duane st., New York.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.; foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

INDIANA.

Position wanted by mechanical engineer and machine designer with technical education and 5 years' experience on general and special machinery. Box 8, AMER. MACHINIST.

MASSACHUSETTS.

Responsible work wanted by technical man, age 33, with drafting, selling and shop experience. Box 15, AMERICAN MACHINIST.

Wanted—Position of responsibility, by young man; 13 years' shop and drafting-room experience; up to date on appliances for turning out work rapidly; understands handling men. Box 536, AMER. MACHINIST.

Position as master mechanic or chief engineer; 18 years' experience with steam and electrical machinery, shafting, belts, waterwheels, indicators and general mill work; temperate, energetic and systematic; A1 references. Box 534, AMERICAN MACHINIST.

MICHIGAN.

Superintendent or general foreman, capable, systematic and experienced, open to correspond. Box 21, AMERICAN MACHINIST.

NEW JERSEY.

Responsible position by young man, experienced in foundry and machine shop management and in the design of cranes and hoists. Box 16, AMERICAN MACHINIST.

NEW YORK.

As mechanical draftsman; 12 years' shop and office experience. Box 24, AM. MACH.

Toolmaker and all-around machinist (experienced as foreman). Box 14, AM. MACH.

Mechanical draftsman and designer (30), 9 years' experience, desires position. Box 6, AMERICAN MACHINIST.

Draftsman, with 10 years' experience on general and special machinery and engineering work. Box 586, AMERICAN MACHINIST.

Draftsman, mechanical, college graduate (24), with 2 years' experience in structural work, desires position. Box 18, AM. MACH.

Plans, drawings and specifications drawn up by a mechanical engineer; moderate charges; evening employment wanted. Box 9, AMERICAN MACHINIST.

Mechanical engineer, gas engine expert, with extensive American and German practice in large engines for blast furnace and producer gas, seeks position as chief engineer or superintendent with gas engine works. Address Box 591, AMERICAN MACHINIST.

By New York man, position as superintendent or manager of a manufacturing establishment located in the South or West; thoroughly competent in all departments, mechanical, electrical, hydraulic, etc.; willing to go abroad. Address Box 25, AMER. MACH.

OHIO.

Wanted—Position; a thoroughly practical gas engine builder, designer, machinist, with or without valuable gas engine patterns, jigs and some machine tools, also successfully demonstrated patents. Address "Expert" care AMERICAN MACHINIST.

PENNSYLVANIA.

Position as works manager or general superintendent; capable of systematically handling a large plant; specialty, air-compressing and air-operated machinery, hoisting engines. Box 2, AMERICAN MACHINIST.

Manager's, superintendent's or other responsible position sought by capable party that has risen, step by step, from shop through drawing room to management of large plants. Box 4, AMER. MACHINIST.

Foreman toolmaker, with technical education and several years' experience at designing and constructing special machinery, jigs and fixtures for manufacturing purposes, wants responsible position with a progressive Western concern. Box 13, AMER. MACHINIST.

RHODE ISLAND.

Mechanical engineer, with wide experience as machinery and supply salesman, this country and abroad, energetic, hustler, with executive ability, open for position of salesman or manager of sales; highest references. Box 12, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and core-makers; we always have vacancies. Address Allis-Chalmers Co., New York Life Bldg., Chicago.

Draftsman wanted, who is expert in designing coal mining machinery, especially hoisting and haulage engines; none but first-class need apply; give experience, age and salary expected. Aetna Foundry & Machine Co., Springfield, Ill.

Wanted—Foreman for foundry making machinery castings; person preferred having had experience in getting large output from Tabor molding machines; state age, nationality and where previously employed. Box 592, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Competent drop forge diemaker; state experience and salary expected. Revere Drop Forge Co., Revere, Mass.

NEW JERSEY.

Wanted—A storekeeper and shipping clerk who has had experience in high-speed engine establishment; write, giving reference and wages expected. Box 10, AMER. MACHINIST.

Superintendent, by manufacturing company, vicinity New York; first-class and experienced man; capable assuming entire charge manufacturing end of business. Box 11, AMERICAN MACHINIST.

NEW YORK.

Wanted—First-class patternmaker; steady employment; state salary expected and experience. Box 20, AMERICAN MACHINIST.

A first-class diemaker who understands to make all kinds of dies for buckles; must have A1 experience in this line; steady position and right salary for the right man; state age and reference. Box 1, AMERICAN MACHINIST.

Foundry foreman with experience in all up-to-date foundry methods, able to handle men to the best advantage and turn out the maximum amount of work in machinery castings in small but fully equipped foundry; mention previous experience, with references, age, salary, etc. Address "Enterprise," care AM. M.

Solicitor.—A rapidly growing concern needs a practical, technical man for their outside department; he must be prepossessing in appearance, aggressive, a good talker and hustler; one having a large acquaintance among manufacturers in New York and vicinity preferred. Apply, with references, to H. C. Wilson, Room 508, 309 Broadway, New York City.

OHIO.

Wanted—A good, reliable, energetic foundry foreman. Box 22, AMER. MACHINIST.

Wanted—Practical draftsman, familiar with jig and tool work for agricultural implement manufacturing company. State experience and address Box 714, Springfield, O.

Superintendent to take charge of factory manufacturing a line of wood-working machinery; young man, capable of making improvements and designing new machinery, to grow up with a new corporation; must be in position to invest $5,000; a splendid opportunity for up-to-date man. Box 585, AM. M.

PENNSYLVANIA.

Wanted—A competent superintendent for machine shop and foundry building hoisting and haulage engines; one who has experience in designing and building Corliss engines preferred; a permanent position for the right man will be given. Address, giving full details as to age, experience and reference, Box 541, AMERICAN MACHINIST.

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Most Of The Tap Breakages And Abuses Come Thro' The Use Of Miserable Makeshift, So Called Tap Wrenches,

generally home made from solid bars any old length, with square holes fitting nothing in particular; or, if so called "adjustable," they are carelessly and shiftlessly made and put together—weak, shaky and short lived. "Anything will do for a tap wrench."

In order to afford an adjustable wrench that will amount to something, we have devised the wrench here shown It is light, strong and serviceable—jaws of best tool steel, stock drop forged, handles of bicycle tubing, and holding taps true and firmly. Made in sizes enough to hold anything ever made in the way of a tap. You'd do well to give this Tap Wrench of ours an honest trial; we've no fear as to the verdict.

Wiley & Russell Mfg. Co.,

Greenfield, Mass, U.S.A.

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Niles-Bement-Pond Co., New York.
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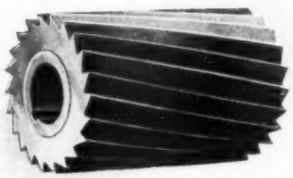

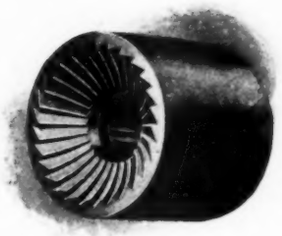

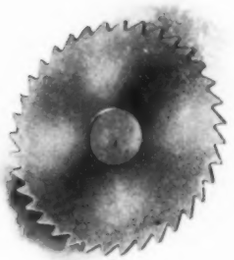

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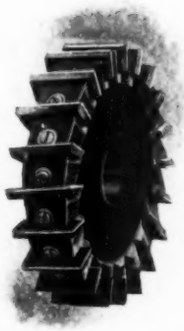

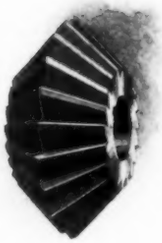

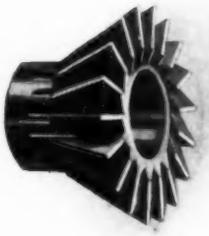

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Perkins Mach. Co., So. Boston, Mass.

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Pratt & Whitney Co., Hartford, Conn.

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Aurora Tool Works, Aurora, Ind.
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Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.

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Fosdick Mach. Tool Co., Cincin., O
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Marshall & Huschart Mchry. Co., Chicago, Ill.
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Niles-Bement-Pond Co., New York.
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Quint, A. D., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
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Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mch. Co., Hartford, Conn.
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Slocomb Co., J. T., Providence, R. I.

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Milwaukee Elec. Co., Milwaukee, Wis.
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Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
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Emerson Elec. Mfg. Co., St. Louis, Mo.
General Elec. Co., New York.
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See Grinding Wheels.

Emery Wheel Dresser
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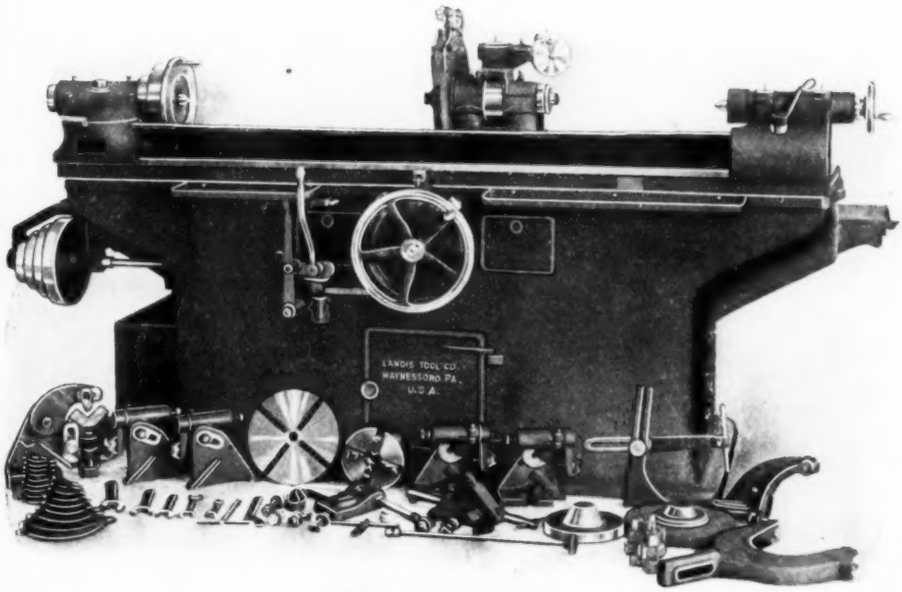
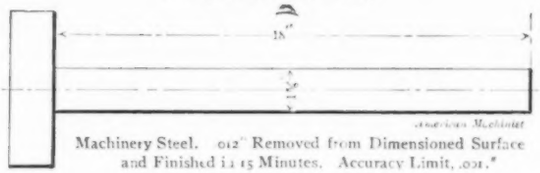
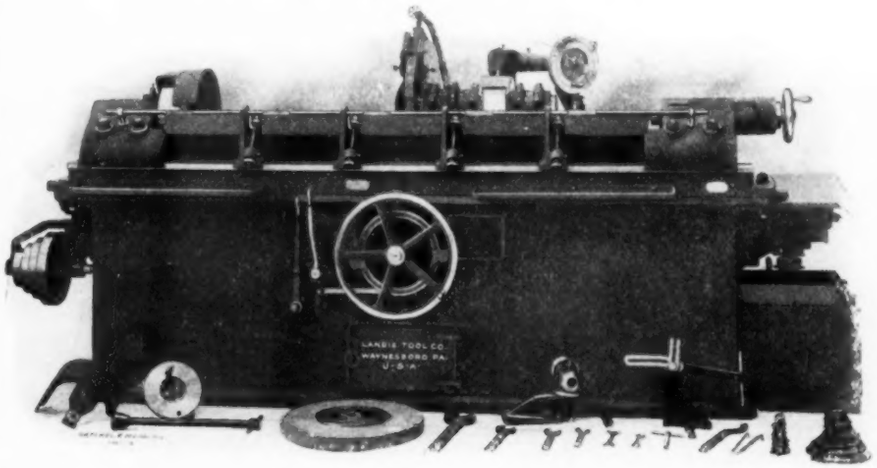
The value of a tool can be determined only by the quality of its work, the time consumed in the production of this work, and the degree of expertness required of the operator.



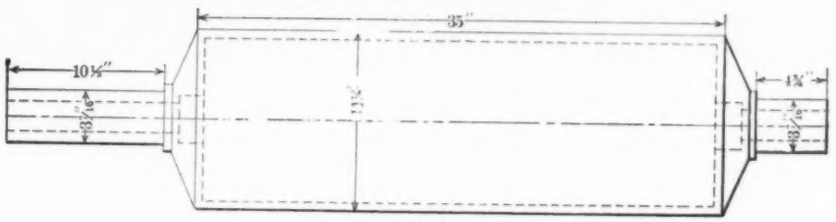
No. 4 Landis Grinder.



Machinery Steel. .012" Removed from Dimensioned Surface and Finished in 15 Minutes. Accuracy Limit, .001."



No. 16 Landis Grinder.



Ironing Roll
.025" Removed. Time: - 40 Min.

Let's take these points up, basing our claims for the efficiency of

Landis Grinders

on the specimens of work shown.

Notice that the first specimen is a piece of machinery steel, from which .012 in. was taken in fifteen minutes, with an accuracy limit of .001 in.

Notice the various dimensions of the second piece shown, and that only forty minutes were required to remove .025 in. Bear in mind that the finish obtained was an exceedingly high one, that could not be obtained in any way but by grinding; and remember that the skill required in this work is far below what would be necessary in the handling of any other class of tools.

Think on these things, and you will understand the wisdom of finishing your work in the "Landis Way." It is the way that leads to success. Send for our book and learn more of the possibilities in this work.

Landis Tool Company,

Waynesboro, Pa. U. S. A.

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Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

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Hawley Down Draft Furnace Co., Chicago, Ill.
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Am. Gas Furnace Co., N. Y. City.
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Messmer Mfg. Co., Ferd., St. Louis, Mo.
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Nuttall Co., R. D., Pittsburgh, Pa.
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Philadelphia Gear Works, Philadelphia, Pa.
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Chicago Raw Hide Co., Chicago, Ill.
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Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
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Gould & Eberhardt, Newark, N. J.
Niles-Bement-Pond Co., New York.

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Rivett-Lock Co., Boston, Mass.
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Besly & Co., Chas. H., Chicago, Ill.
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Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
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Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
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Landis Tool Co., Waynesboro, Pa.
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Niles-Bement-Pond Co., New York.
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Safety Emery Wheel Co., Springfield, O.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Special Tools for Rapid Planer Work.

BY E. E. WOOD.

The milling machine has of late years largely usurped the former field of the planer. Having had considerable more or less unsatisfactory experience in milling lathe beds, it was natural to return to planing, and while a time-killing operation, it was in the end satisfactory as to quality. I do not want to go on record as condemning the milling machine; far from it. It is indispensable in its place, but, unlike some of the patent medicines, it is not a cureall for everything.

In returning to the planer I had some ideas for special tools and fixtures for the rapid planing of lathe beds, which were opposed to all previous practice, and in fact I was told by a number of machine tool builders that the job could not be done as I proposed and produce good work. The general practice to-day, as well as in the past, is to finish the V's or carriage ways with a single tool feeding down with the tool carrier set over to 45 degrees. In my method the first operation is to rough off the scale, and, by using a variable-speed countershaft or else a variable-speed motor and round-nosed tools, this operation can be accomplished very quickly, provided the planer can accommodate two rows of beds, with two heads on the cross-rail and two side heads, operating them all as far as possible. With the new high-speed steels a surface speed of from 40 to 50 feet per minute can be maintained and with a generous feed.

Roughing and finishing the V's is accomplished by using a special cast-iron tool-holder with also special forming tools. This holder is attached to the machine by running the regular tool carrier up as far as possible and sliding the tool-holder below it on the same slide, using a short gib to clamp it. The adjustment up or down is provided by a connecting link clamped in the regular tool-holder in the usual way, the lower end connected with the special tool-holder.

Fig. 1 illustrates this device ready for use. Fig. 2 represents in detail the tool-holder, the forming tools and the connecting link respectively. It is better to have two sets of these fixtures, one for roughing and one for finishing. The cutting edges of the forming tools are at an angle, so that in finishing the V's they get a shear cut, which produces a much better surface and requires very little scraping at the final finish. The planer should not be run above 15 feet per minute for this scraping cut.

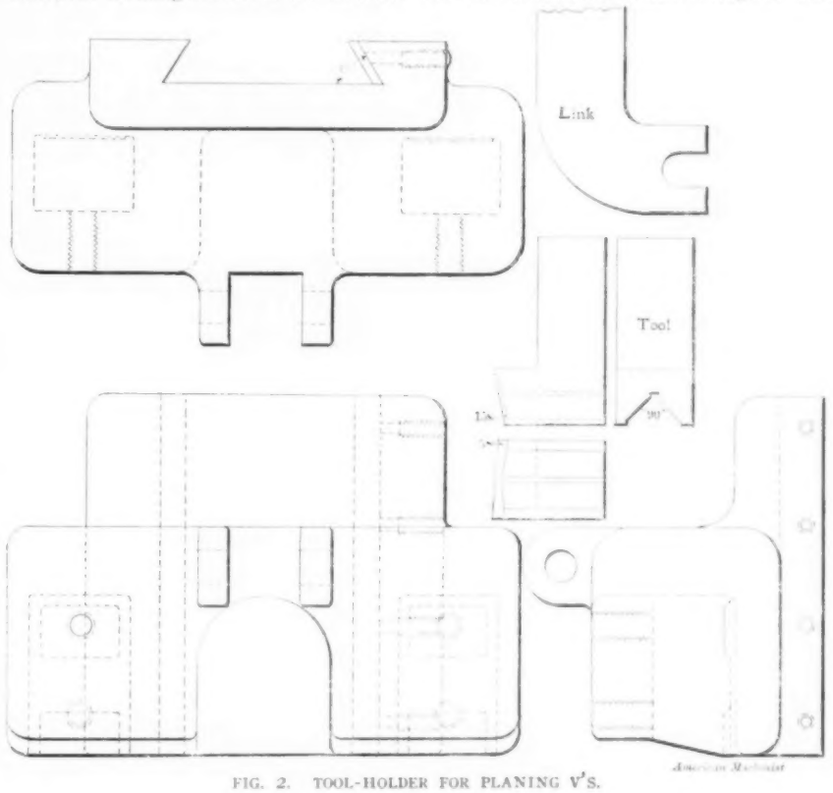


FIG. 2. TOOL-HOLDER FOR PLANING V'S.

The mistake others have made in trying to make use of a tool of this kind has been that they have clamped it in the tool-holder instead of under and on the ways of the tool-holder, which brings it back as near the cross-rail as it is possible to get it, therefore securing the rigidity required for strictly accurate work.

To finish the flat space between the V's a holder is used and applied to the machine in the same manner as the one described, except that the tool-holder is designed to carry a broad tool set at an angle (horizontally) of 30 degrees, it being much less liable to chatter at this angle

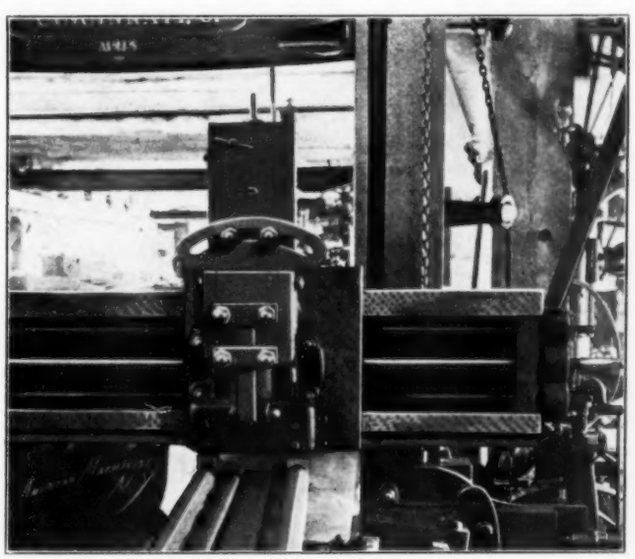


FIG. 1. PLANING THE V'S.

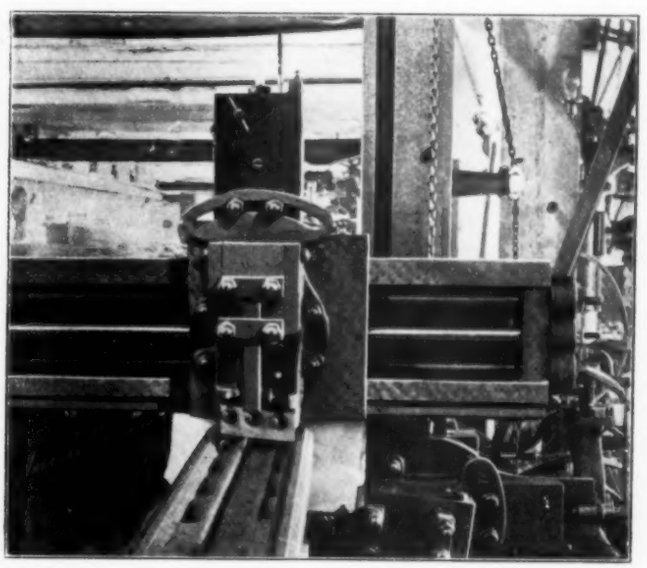


FIG. 3. PLANING THE FLAT BETWEEN THE V'S.

than if set straight or parallel with the cross-rail. Cuts of from 8 to 12 inches wide can be made with this tool by running the planer about 15 feet per minute. Fig. 3 illustrates this device in use, and

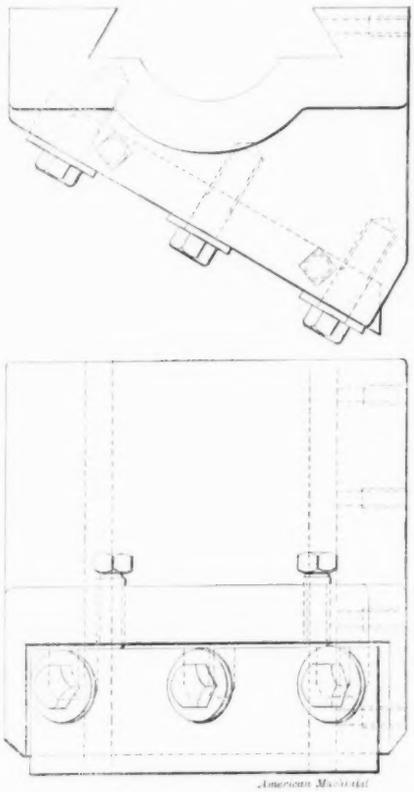


FIG. 4. HOLDER FOR FLAT TOOL.

Fig. 4 shows the cast-iron tool-holder and cutter in detail.

These operations having disposed of the top of the bed, we come next to the under cut for the carriage gibs. The two side heads of course could take care of the two outer edges, but they are not provided with a cross feed, also the tools clamped in the two heads on cross-rail to cut under the two inner edges have to drag the whole length on the return stroke, which soon destroys the cutting edge; also we wanted to have all four heads cutting at the same time. To accomplish all this I designed two tools for the two inner under cuts, which have proved very satisfactory. As rigidity was of course required, we used 2¼-inch square stock, as large as could be clamped in the holders. The lower end was tapped or threaded with 2-inch, four-pitch U. S. standard thread for a depth of about 3½ inches, and a forging was made with a shank threaded to fit the holder, also a square hole provided to clamp the cutting tool. The shank of the forging was not screwed down to a seat, but left away a little, and a stud was inserted for a stop against the holder, which prevented it from turning while the tool was cutting; but on the return stroke, as soon as the tool commenced to drag, it had a tendency to unscrew the forged holder and thus release the tool. A spring was provided to return the same to cutting position at the end of the return stroke. Fig. 5 illustrates this arrangement in use, and Fig. 6 shows the details. The holders were of course made right and left.

Note the chain and sprockets at the ends of the cross-rail; these connect the two long feed screws with the feed screws of the side heads, the difference in sizes of sprockets compensating for the difference in the lead of the two screws, and thus allowing all four heads to feed at the same time.

Before designing and applying these devices the time taken to finish four lathe beds, each 7 feet in length, ready for the scrapers, was fifteen hours on the planer and forty hours on the milling machine, and since applying the special devices the average time consumed is eight hours, which makes a material and gratifying saving, and the expenditure for special tools was very rapidly made good. In justice to the milling machine, I would say that the machine used was not a strictly up-to-date machine.

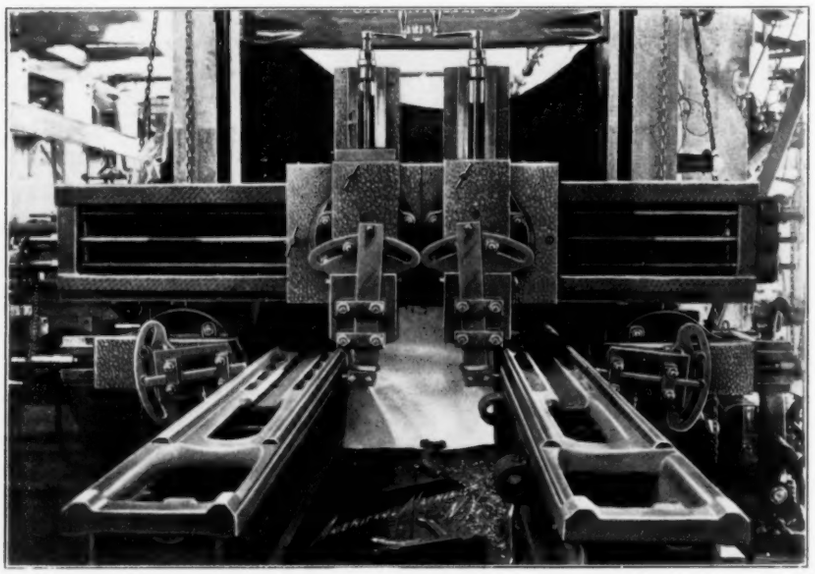
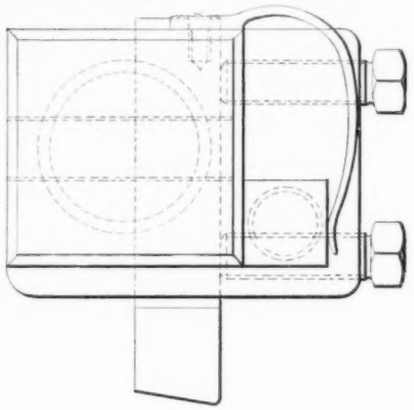


FIG. 5. UNDERCUTTING BOTH EDGES OF BOTH BEDS AT ONCE.

Discussion in France of the Question of the Adoption of the Metric System by the United States Government.

We have previously alluded to the fact that the paper by F. A. Halsey read before the American Society of Mechanical



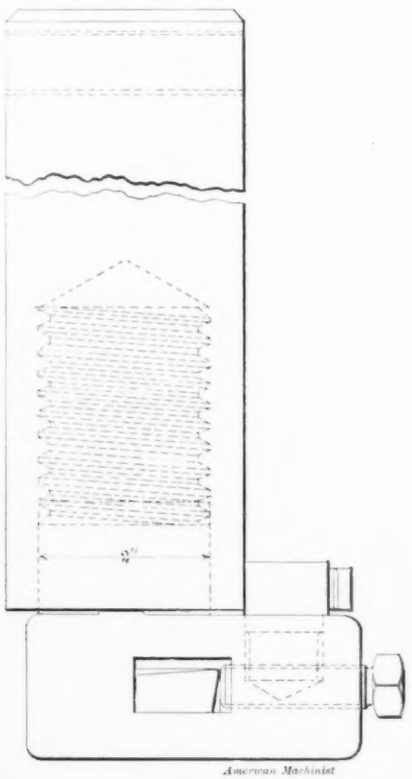


FIG. 6. TOOL-HOLDER FOR UNDER PLANING.

Engineers a year ago was to be translated into French and that the American Chamber of Commerce and the *Societe des Ingenieurs Civils de France* were to consider it. We have received from the secretary of the first-named body "Bulletin No. 23," which contains a record of what took place at a meeting at which the matter was considered. In the preface it is

explained that at the request of the American Chamber of Commerce the conference of May 1 of the *Societe des Ingenieurs Civils de France* was devoted to the consideration of the adoption of the metric system by the government of the United States, but that certain questions that were to be asked did not reach the members until the day of the meeting and therefore too late to be fully considered. A committee was therefore appointed to consider them, this committee consisting of Messrs. P. Bodin, president of the society; L. Caen, P. Chalon, Ch. Ed. Guillaume, H. Lenicque, Ed. Simon and R. Soreau. The preface then goes on to say:

"The replies will impress all with their direct simplicity and fair-mindedness and should forever do away with the vague notion that after 100 years France has not succeeded in substituting the new system for the old.

"It is well known how the American Chamber of Commerce has long advocated the adoption of the metric system by our government. It appears that the opponents of the adoption of the metric system by the United States, in discussing the measure, drift into a mass of detail and supposition, while the testimony of those having had most experience is that the change from our present confused system to the simple metric system can be accomplished without serious difficulty and within a reasonable time. Such a step would simplify the work of the people and break down a barrier to the common thought of the world."

The bulletin is an extract from the minutes of the meeting, and in places is not nearly as full as one could wish. It has been translated by Laurence V. Benet, honorable secretary of the Chamber.

Francis Kimbel, former president of the society, in speaking said, among other things:

"The persistence in France of certain of the old measures has no greater real importance than the survival of certain dialects in the country districts side by side with the French language. The metric system is the only one taught in the schools, and the only one employed in official documents and in public laws.

"The decimal division of angles is being adopted slowly but surely by the departments of the government; the Navy, under the direction of Commandant Guyon, of *l'Institut*, and encouraged by the *Bureau des Longitudes*, has carried out long trials in this direction, and has clearly demonstrated the advantage of the division of the circle into 400 *grades*. Astronomy alone, tied down by its traditions and by the forced retention of the day of 24 hours, appears to be constrained to continue for some time longer the old division of 360 degrees."

Monsieur Simon refuted certain passages of Mr. Halsey's paper from which it could be inferred that the lack of uniformity in the numbering of yarns was due to difficulties inherent to decimal metric measures.

He pointed out, first of all, by reading certain extracts from a paper read at the *Conference generale des Poids et Mesures reunie a Sevres en 1901*, that as far back as 1810 the idea of the *kilogrammetrique* numbering of yarns was developed, and that it was adopted at the various congresses that followed at Vienna in 1873, at Brussels in 1874, at Turin in 1875, and at Paris in 1878 and 1900. These different congresses, as a matter of fact, chose as basis of unification the *metre* and the *gramme* or their multiples.

He cited certain objections of Mr. Halsey, who tried to prove that the British system of numbering was employed for the greater part of textiles, and who criticised especially the French and German systems on account of their confusion and complexity. Monsieur Simon demonstrated by clear and searching examples how on the contrary the multiplicity of English systems complicates the numbering of yarns, and stated that in reality the British dealers employ more methods of numbering than there are textile materials.

Monsieur Simon explained that if in France the wished for unification has not yet been realized, this is due on one hand (for domestic consumption) to certain local habits, and on the other (foreign trade) to the fact that England, being preponderant in the textile market, the French weavers are forced to employ the English system as long as England does not adopt the *kilogrammetrique* system.

Monsieur Edouard Sauvage, *Ingenieur en Chef des Mines*, then took the floor.

Monsieur Sauvage said that the international system of screw threads is a good example of the application of the metric system to mechanical engineering. For a long time, the screw, employed in such vast numbers in machine construction and metallic structures, being designed without general rules, each manufacturer employed a different type, and generally one that was not properly defined. The English system of Whitworth, having the inch for base, was largely employed on the continent of Europe, but often with certain modifications.

The *Societe d'Encouragement pour l'Industrie Nationale* undertook to correct this state of affairs in France, and after a long study of the question laid down in 1894 the rules of the French system, which were rapidly adopted by the French Navy, and by several railroad companies.

The importance of this question aroused the attention of engineers of all countries using the metric system abroad. The Swiss Manufacturers' Union took up the matter, and in 1898 brought about a congress of engineers and delegates from technical societies of all Europe, which met in Zurich. This congress laid down the rules of the international system.

"This system," the speaker continued, "differs, as a matter of fact, very little from the French system; the form of thread is the same; only in the case of the diameters of 8, 9 and 12 millimeters is the pitch different (1.25 and 1.75 millimeters); in addition, the series of standard threads, the use of which is recommended as preferable to screws of other diameters, is different in the two systems; the series of the international system is more extended and better satisfies the needs of the manufacturer.

"The profile of the thread is exactly that of the Sellers system employed in the United States (based upon the inch), and this fact would appear to facilitate its adoption in place of the Sellers system.

"The departments of the French Government which had adopted the French system did not hesitate about making the necessary corrections in order to substitute the international system, which rapidly extended to a large number of establishments. In France it is employed in naval constructions, by all of the great railroad companies, by large works such as those of Schneider & Co., of Creusot, Fives-Lille, etc.

"It is clear that this substitution of a new system of screw threads for the old systems is not without complications nor without expense. All manufacturing tools and gages have to be replaced; furthermore, during a certain time it is necessary to have on hand a stock of screws of the two systems in use. The French engineers not hesitating at these small practical difficulties, and boldly adopting this system, the advantages of which were apparent to them, have given a fine example of decision and of love of progress. We are accustomed to believe that the Americans are never checked by such obstacles, but go resolutely ahead when they see a progress to be realized; we can now show that our country can give, when required, such proof of vitality and energy that it has shown to our American friends how it is necessary to proceed in order to bring about the application of the metric measures."

The president remarked that Monsieur Sauvage was the author of the question that he had just treated, and thanked him for his clear explanations.

Monsieur Chalon repudiated forcibly the objection made by Americans to the adoption of the metric system, based upon the pretended persistence of the old measures in France. He remarked that this objection, which had made a great impression in the United States, and which the enemies of the metric system had spread abroad through the medium of the press, was untrue, and even ridiculous. He demonstrated by numerous examples that the old names which persist in France were not the old measures; these were simply popular expressions, habitually used to express certain metric and decimal divisions.

Major F. A. Mahan (retired) asked permission, as an officer of the United States Corps of Engineers, to say a word on this

subject. He said that in the United States all river and harbor work was carried out by the Corps of Engineers of the Army. In 1874 he was attached to the work on the Ohio River under the direction of Colonel Merrill. The problem was to establish a channel by means of movable jetties. As nothing existed in English on this subject, it was necessary to obtain information to consult French publications. In these everything was expressed in metric measures, and it became necessary to employ them. In 1876, Major Mahan came to France, where he spent three months in studying the interior waterways. His studies gave him a great deal of experience with the metric system, the value and convenience of which he soon realized. Since then he had employed it a great deal, and above all when he had had difficult computations to make. Often he had converted his American data into metric terms; made his computations, and reconverted the results. By this means he had often realized an economy in time of 50 per cent.

But, on the other hand, the mind had an inertia that it was difficult to overcome. Although he was a great partisan of the metric system, and had employed it largely for thirty years, he had always experienced great difficulty in thinking in this system. When stresses of so many *kilogrammes* per square *centimetres* were mentioned, no idea was conveyed to his mind, and he found it necessary to convert them into pounds per square inch It was very difficult for Americans, who had the habit of the latter form of expression, and who heard no other about them, to at once understand what was meant by measures expressed in *kilogrammes* and *centimetres*. This form of expression frightened the American people a little, because they did not understand it, and it was difficult to make them appreciate the great advantages of the metric system over the one actually in use.

Monsieur Cheysson, *Membre de l'Institut*, took up the economical side of the question. It seemed to him that all of the objections presented by the adversaries to the introduction of the metric system might be summed up by the practical argument: "It is not clear that any commercial advantage would result from the adoption of the metric system by the United States."

Monsieur Cheysson explained that an identity of language figures among the factors which could influence the relations between different countries. If it was difficult to determine mathematically the value of this influence, it was in no case important; by its continued influence, it finally made itself felt in the law of supply and demand, and thus reacted upon commercial intercourse.

Besides this, and always from a practical point of view, it was a great economy to relieve engineers, accountants and, in a word, all computers of a country, from the loss of time inflicted upon them by an inconvenient system of weights and measures. The Americans were precisely the people who never hesitated before any sacrifice in order to improve their mechanical equipment. Why, in the case of measures, did they cling to an inefficient tool that has been successively cast aside by all other countries?

Finally, Monsieur Cheysson, basing himself upon the words of the preceding speakers, showed how the American system was eaten into by the metric system on all sides, for geodesy, electricity, screw cutting, designation of textiles, etc. He closed by saying that he was firmly convinced that when the American people made up their minds they would bring to the rapid adoption of the metric system those qualities of decision and energy, of which they had already given so many proofs, and thanks to which they had realized in a few years a progress that would have elsewhere required centuries to accomplish.

Among the answers to questions that seem most interesting or enlightening are the following:

Question 7.—How is it that the non-decimal division of the franc into "*sous*" is more generally employed than the decimal division into *centimes*? Is it true that it is proposed to coin a non-decimal piece of 25 *centimes*, and why?

Answer 7.—The name *sou*, employed only in speaking, is merely an old popular appellation applied to the new piece of 5 *centimes*. But in all transactions, however—even the most common—0.05 F. is always written—which of course is a decimal fraction. So, also, the coin of 0.25 F. not yet in circulation (1) is a strictly decimal fraction in conformity with its proper definition. The real unit is the *franc*, which, with its decimal subdivisions, serves as the basis of all monetary calculations.

Question 16.—How can it be explained that the persistent efforts of the authorities and the stringent laws on the subject of weights and measures have not succeeded, after more than a century, in preventing the every-day use of the old measures?

Question 17.—Can it be denied that there actually exist two systems of weights and measures in France, the metric system and the old system of weights and measures?

Answers 16 and 17.—At the commencement of the application of the metric system in France there was, frequently, hesitation, owing to a great extent to the radical changes in the political regime. But the metric system was not really legal to the exclusion of every other, until January 1, 1840—that is to say, a little more than sixty years ago. To-day only one system of measures exists in France, and it is absolutely incorrect to say that the old measures are still employed in this country; even their values are becoming more unknown. The popular names of the old measures which, as stated before, designate, at the present time, metric measures, have given rise to the belief that the two systems are coexistent: the only notable exception is to be found in those industries or trades in which foreign nations which have not yet adopted the metric system have such a preponderating influence as to thus far impose the use of their own measures.

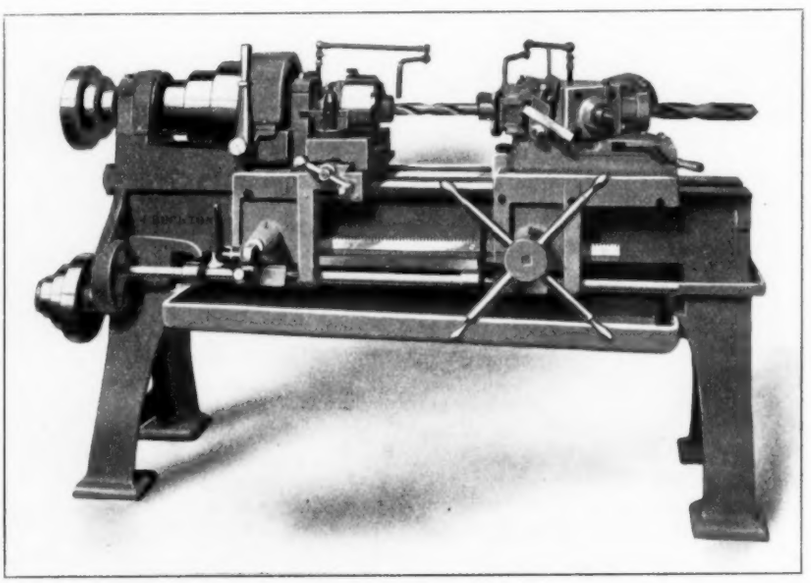


FIG. 1. AN ENGLISH TURRET LATHE.

An English Turret Lathe.

The accompanying engravings illustrate a turret lathe for general shop purposes, it being designed especially for handling bar work and castings and forgings where machined in insufficient quantities to warrant the employment of special equipment for each class of work.

The spindle of this tool carries, as shown in the half-tone, Fig. 1, a three-step cone; this is driven from a two-speed counter-

shaft by a 3½-inch belt, the transmission being direct to the spindle by a friction clutch, or through back gearing running within the headstock and bed, and a positive clutch, the change being made by means of the lever in front of the head. Twelve spindle speeds are thus available. The spindle has a 2⅛-inch bore admitting a 2 1-16 inch rough bar, and the nose is threaded to receive a special three-jaw universal chuck which can be replaced by an ordinary face-plate, a plug carrying a live center then being inserted into the taper mouth of the hole through the spindle. Cutting off, forming, or ordinary

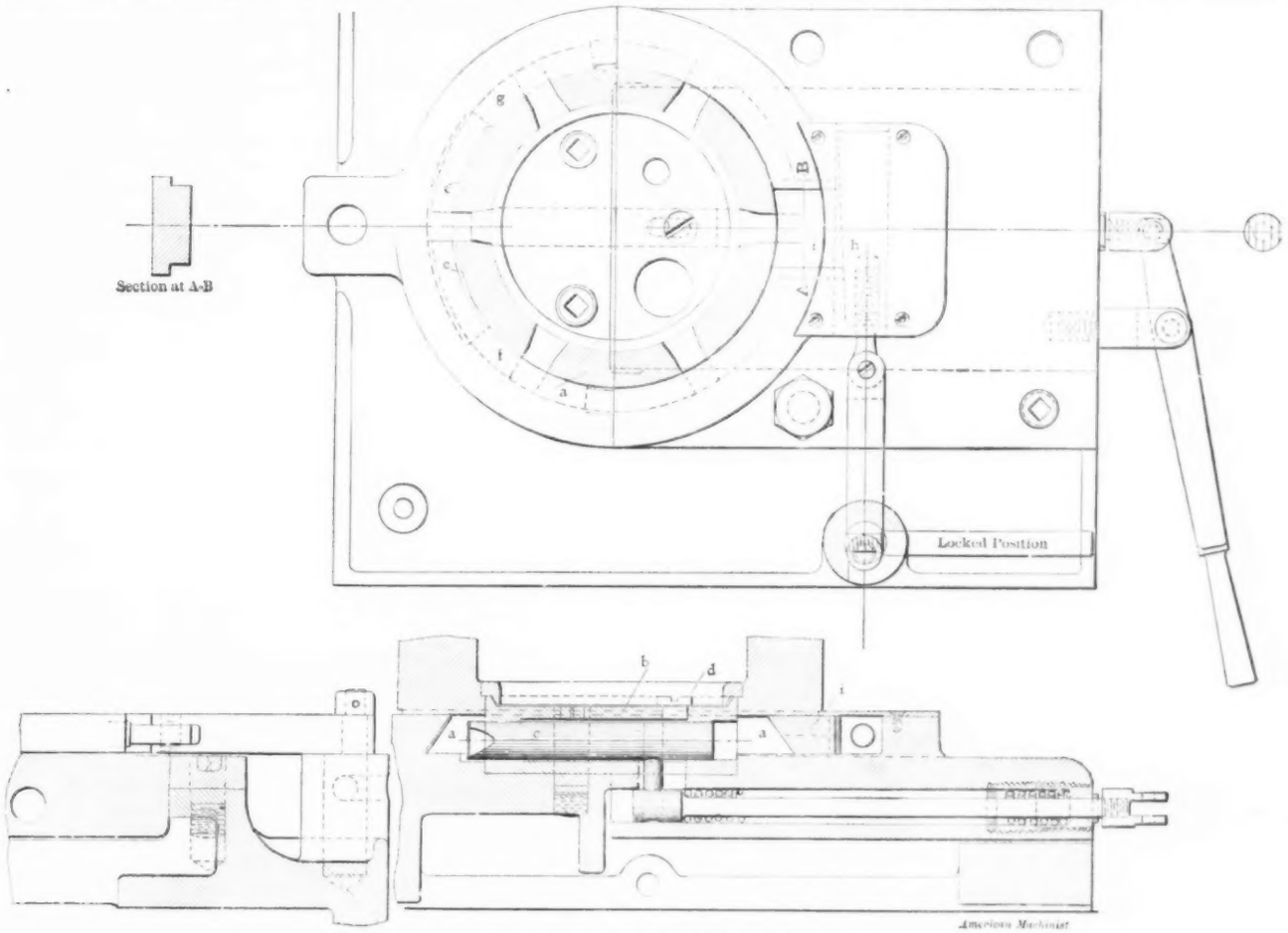


FIG. 2. THE TURRET MECHANISM.

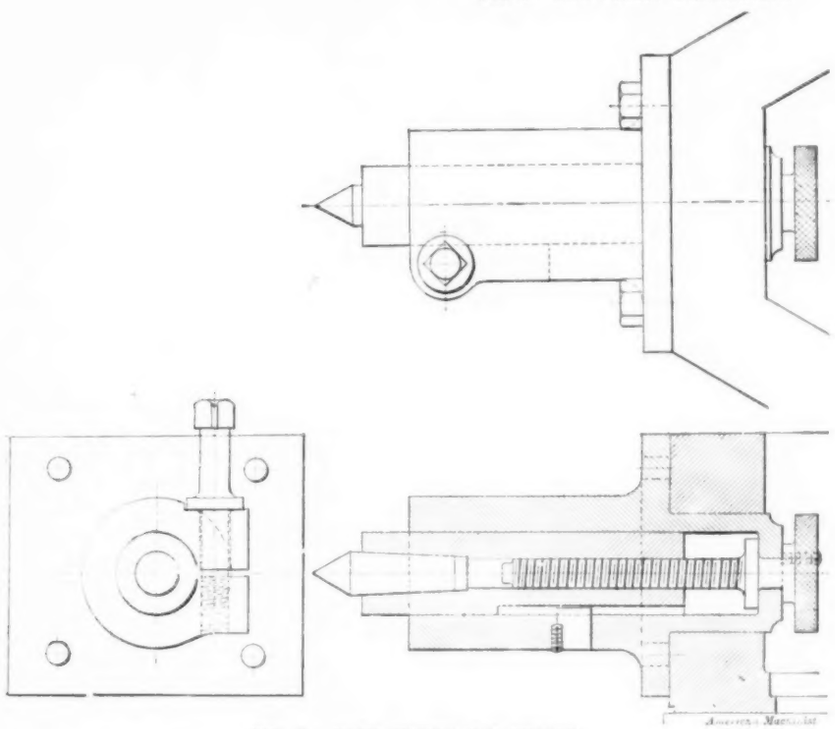


FIG. 3. BACK CENTER FOR TURRET.

turning and facing operations are performed by tools held in posts at the front and back of the cross-slide, this being fitted to a traversing saddle which is provided with three rates of power feed thrown in by a handle projecting toward the operator and tripped automatically by an adjustable stop on the feed rod, or by the operator pressing a trigger which releases a drop worm. At the back of the bed is a taper turning attachment which is adjusted to a graduated scale to give the taper per foot and admits of the traversing saddle being used for turning tapers of any length within the full capacity of the lathe. While turret operations are being performed, the carriage with the cross-slide can be brought up under the chuck, and out of the way, thus allowing the turret tools to operate clear up to the chuck face.

The turret, which is hexagonal as shown, is secured to its saddle in the manner represented in Fig. 2. It will be seen from this drawing that the undercut or coned bearing ring *a* formed at the bottom of the turret fits in a seat one-half of which is formed in the main body of the saddle

or carriage, while the rear half is machined in an auxiliary casting securely fitted and bolted in place after the turret is dropped into position. At *b* is represented a stationary central disk carrying the locking pin *c* and above this a guard ring *d*. The front portion of the bearing for the turret is cut away (as shown in the plan with turret broken off at the base) at *e*, leaving two bearing surfaces at *f* and *g*, whose contact is well out toward the sides of the turret rather than at the front. The locking pin *c* is withdrawn by means of the lever at the rear end of the saddle, and the turret turned by hand until the lock bolt again drops into place to locate the turret. The latter is then locked by a wedge *h* pulled forward by an eccentric stud and link at the front, the wedge forcing a shoe *i* squarely against the rear of the bearing and clamping the turret fast without in any way disturbing its alinement.

The turret has three rates of feed by power, the mechanism for throwing in or releasing the feed being identical with that employed in the case of the traversing saddle feed. In addition to the usual turning tools, drill holders, die heads, etc., bolted to the turret faces, a special tail center is carried which is constructed as shown in Fig. 3. When this is in use the turret is brought by hand to the required position and clamped to the bed by the locking bolt in the point of the saddle; the turret is then clamped with the center in line with the live spindle. The spindle with this special center may be adjusted and clamped like the footstock spindle of a lathe and long forgings with collars, forged bolts, and similar parts can thus be conveniently dealt with, one end being gripped in the chuck and the other end steadied by the back center while being turned by a tool in one of the carriage tool-posts; the piece may then be threaded, if desired, by means of the die head before removing from the chuck.

A regular steady rest to fit the ways is provided for use when drilling pieces requiring an outer support; and both cross-slide and turret carriages are equipped with oil pipes which travel with the tools and convey to them lubricant supplied from the oil pan by a geared pump at the rear of the bed.

This turret lathe swings 16 inches over the bed and 9 inches over the carriage. The maximum travel of the turret is 21 inches and the working travel of the saddle, 15 inches. The cross-slide has a 7-inch movement. The machine weighs 2,800 pounds; it is built by Joshua Buckton & Co., Limited, Leeds, England.

Arc Milling and Boring Rigs.

BY GUSTAV FIEDLER.

An arc-shaped piece shown in Fig. 1, with a radius of 36 inches and a length of about 19 inches, and a sleeve shown in Fig. 2 to be fitted to it, had to be made at our place some time ago. The largest lathe in the shop had a swing of only 46 inches, but even if we had had a lathe large enough, the upset at one end of the arc would have prevented its use. The job was in a hurry, as such jobs usually are, especially if the shop has no convenient tools for doing them and we had to find some way to do the work and that immediately.

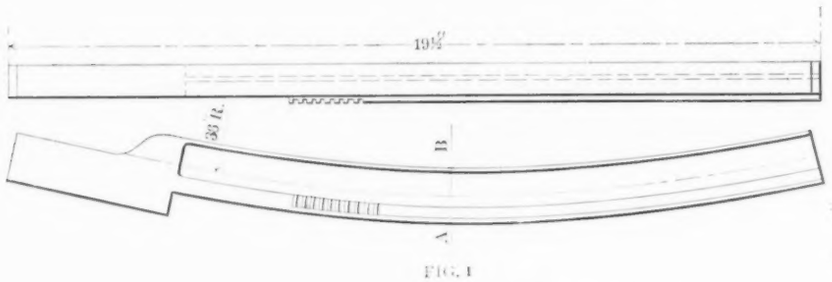


FIG. 1 THE WORK TO BE DONE.

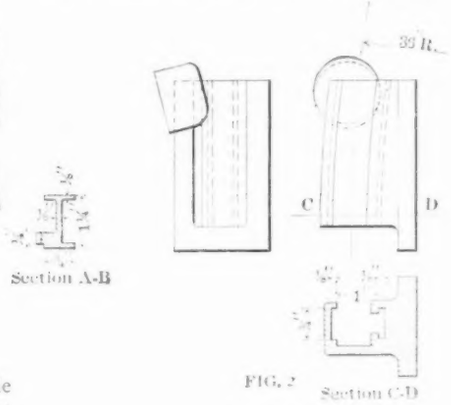


FIG. 2

A Becker vertical miller we thought would solve the problem, and the arrangement shown in Fig. 3 was soon perfected. A bar iron *a*, about 42 inches long by 4 inches wide and 1 inch thick, was planed on both sides and on one end, and in the other end a hole was drilled to receive a fulcrum pin *b*, the planed end being fastened to the milling machine table. Two more pieces, *c* and *d*, about 2 inches by ½ inch and 40 inches long, were procured and in one end of each a hole was drilled to fit the fulcrum pin *b* in piece *a*. The two other ends were spread apart and fastened to a connecting piece somewhat longer than the arc to which the arc was fastened, as shown in Fig. 3. A clamp *e* was put on one side, to give the swinging arm some friction.

A lathe stood just in front of the milling machine and, by connecting the swinging arm to the lathe carriage by piece *g*, we obtained a good, steady feed. We saw that removing the body of metal from the middle of the arc by milling would be a slow job, but by taking an old twist drill 1-32 inch smaller than the groove in the arc, fitting the shank of the drill to the draw-in chuck of the milling machine and drilling holes along the middle of the groove so that they overlapped each other about ⅛ inch, the metal was soon removed and then finished with the milling cutter in a short time. For milling the reverse side, two holes *f f* were drilled near the inside of the finished arc, two pins just large enough to come in contact with the arc were fastened in them, the arc was reversed and the second side finished the same way. For cutting the curved teeth the whole rigging was removed to a Brown & Sharpe milling machine with a vertical milling attachment, which was set on an angle of 14 degrees, the angle of the engaging spiral gear and the teeth were cut with a cutter shown in Fig. 4. The spacing was accomplished by fastening a micrometer lathe stop on one end of the rigging and cutting two teeth to the proper pitch. The lathe stop was then removed, a latch was made to fit the shape of tooth cut and fastened to a little angle plate back of the arc. The spacing was then done by cutting one tooth, relieving the latch and moving the arm forward till the latch would engage in the next tooth, and clamping the swinging triangular arm with the arc down again and cutting another tooth.

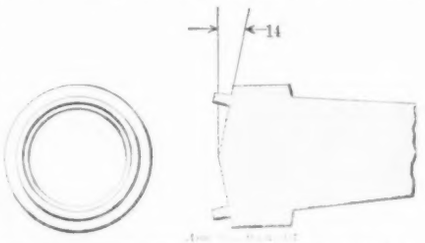


FIG. 4. CUTTER FOR CUTTING CIRCULAR TOOLS.

Reference to the illustration of the sleeve, Fig. 2, will show that milling was out of the question. Fig. 5 illustrates how it was done. Taking the same bar of iron *a* we had used on the milling machine, we fastened to its planed end an angle-plate *i* and bolted the sleeve *j* to the plate. A slot *g* was formed by bolting a straight piece to the narrow side of bar *a*, as shown. In the face-plate of a 16-inch lathe a stud *h* was put in at such a distance from the center that the diameter of the circle it would describe would be somewhat longer than the length of the sleeve we had to fit to the arc. This lathe was then put in front of another lathe, and at such a distance that when arm *a* with a

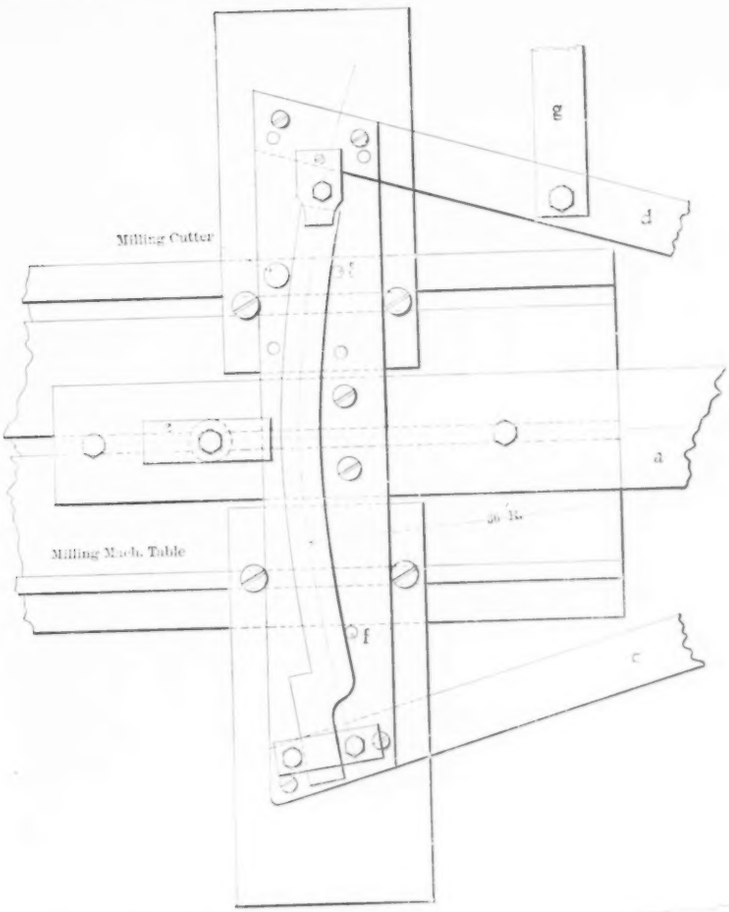


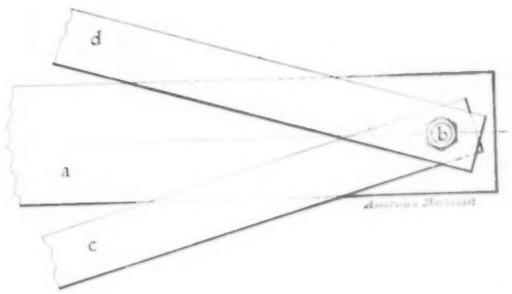
FIG. 3. FIXTURE FOR MILLING ARC.

stud was put between centers on one lathe the stud on the face-plate on the other lathe was just in the center of the slot on the other end of the bar. This stud *h* had a large shoulder, so to hold the bar against the face-plate with some friction. The lathe was belted up to lathe back of it, giving to the arm a swinging up-and-down motion somewhat longer than the sleeve. Further description is unnecessary.

Mining Royalties.

Sir I. Lowthian Bell, in his "Principles of the Manufacture of Iron and Steel," pages 603 to 610, estimates the royalties on a ton of pig iron from ironstone, coal, etc., to amount to 3s. 6d. per ton in the Cleveland district, to 6s. in Scotland, and to 6s. 3d. in Cumberland, whereas our competitors in Germany pay 6d., in France 8d., and in Belgium 1s. 3d. Surely the difference between the royalties paid in Cumberland and those paid in Germany form more than "a small proportion of the cost of iron." In the United States royalties are almost unknown. The above facts help to explain why in America, notwithstanding many additional charges in other directions, steel can be produced cheaply. The facts also suggest possible directions for securing the cost of production of the raw materials of engineering which are generally overlooked and which hitherto have not received as much attention as they deserve.—*The Mechanical Engineer.*

From the above one might conclude that our esteemed contemporary thinks that because royalties as such are not generally paid by mine operators to mine owners in America the public get the benefit of them. How then does it account for the fact that most of the estimated valuation of the



United States Steel Corporation is in its ownership and control of iron ore and coke supplies? Obviously the only thing that makes them worth mentioning as assets of the corporation is the fact that what is equivalent to mining royalties are paid by the buyers of the finished products, and the increased valuation of these monopolies which is so confidently predicted for the future can take place only by increased payments of this nature.

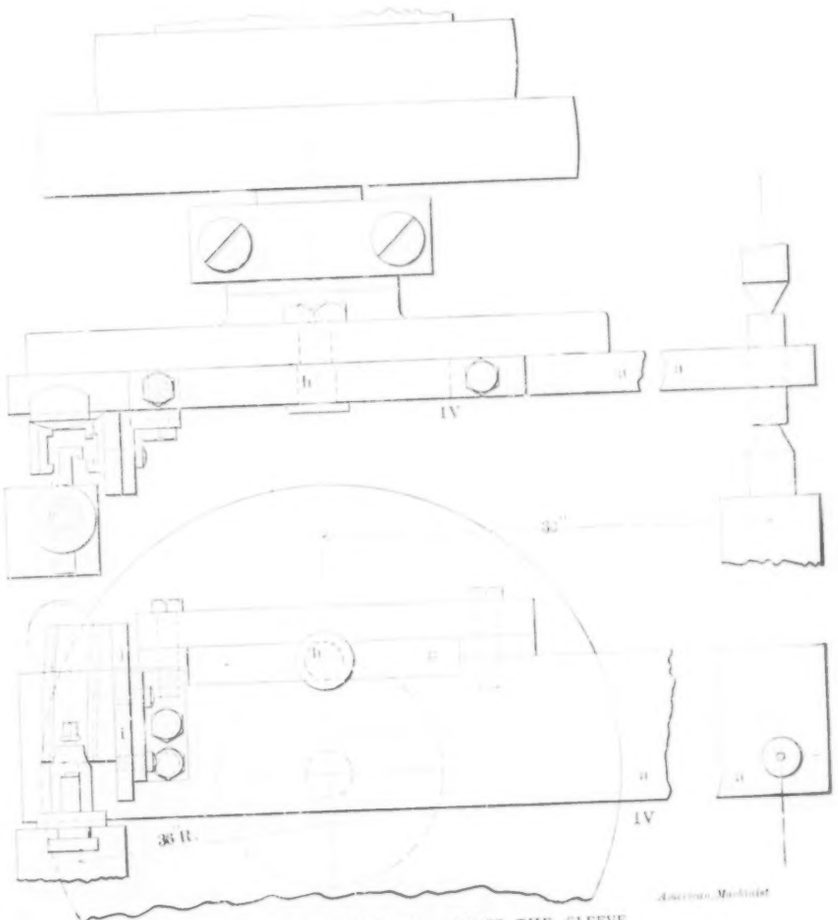


FIG. 5. FIXTURE FOR BORING THE SLEEVE.

The Machining of Multiple-Throw Crankshafts.

Having described in a previous article the methods followed by the Tindel-Morris Machine Company, of Eddystone, Pa., in machining single-throw crankshafts, we now show their latest Tindel-Albrecht crankshaft lathe for multiple-throw shafts, although it is, of course, equally applicable to single-throw shafts.

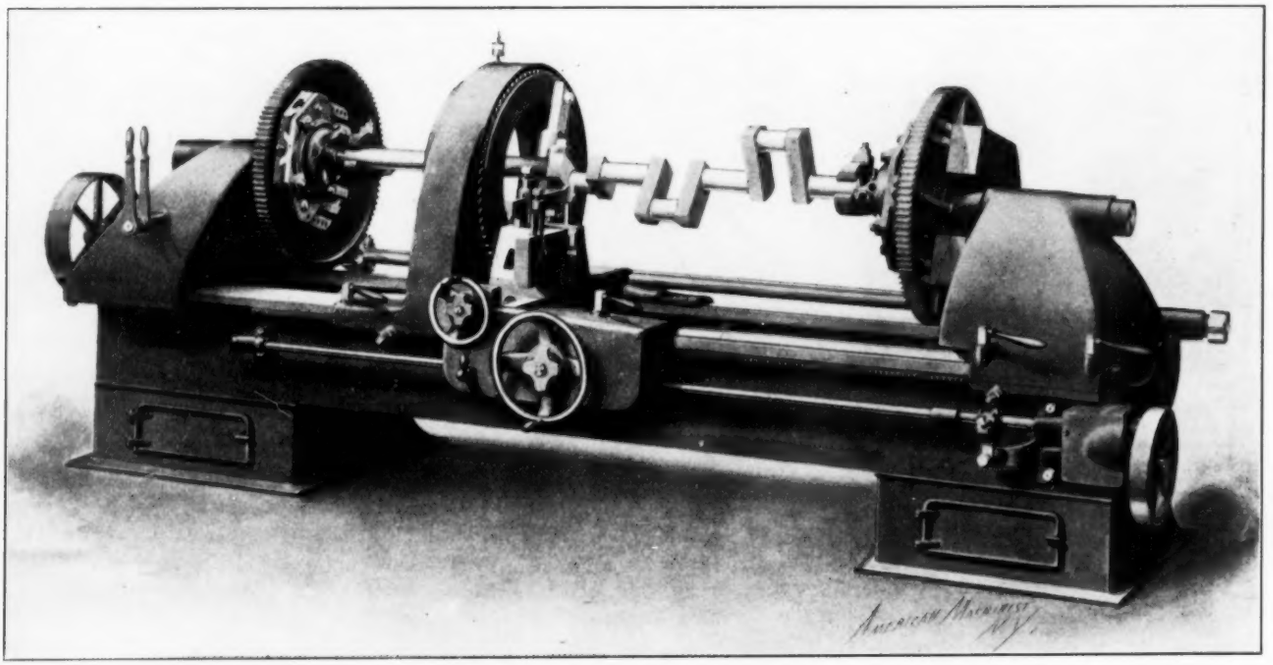


FIG. 1. THE TINDEL-ALBRECHT CRANKSHAFT LATHE.

The forgings for this class of work are crude, and the throws and wrist pins must be literally "dug out" of the solid. A high degree of accuracy is required, but, with the complex shape of the shaft and the correspondingly complex strains to which it is subjected when driven from one end, deflections occur which make the attainment of accuracy a very difficult operation. Added to this are the difficulties of securing accurate throws, spacing and parallelism of the shaft and pins, all of which difficulties grow rapidly with the number of cranks.

In the case of single-throw shafts, as described last week, the turning of shaft and pin is done on different machines and the slotting and milling of the cranks come between the work on the two lathes. The lathe now to be described is, however, intended for turning both shaft and pins, and the slotting and milling precede the lathe work—the shafts coming to the lathe ready for the completion of all the lathe work.

The multiple-throw lathe is shown in Fig. 1. Its starting point is the driving of the work from a ring driving head or driving steady-rest, as in the lathes shown in the previous article. In the lathe now shown this head is, however, adjustable lengthwise of the bed in order that it may always be set to drive the work by the crank cheek nearest to the part of the work being turned. In addition to this, both headstock and tailstock face-plates are driven, not however to transmit any turning effort to the work, but to insure its true revolution and its maintenance in parallelism with the center line without angular displacement. To avoid back-lash and insure smooth running, the pitches of the driving gears of the steady rest and face-plates are made to differ, that of the steady rest being much the coarser.

Fig. 2 shows the steady rest in detail.

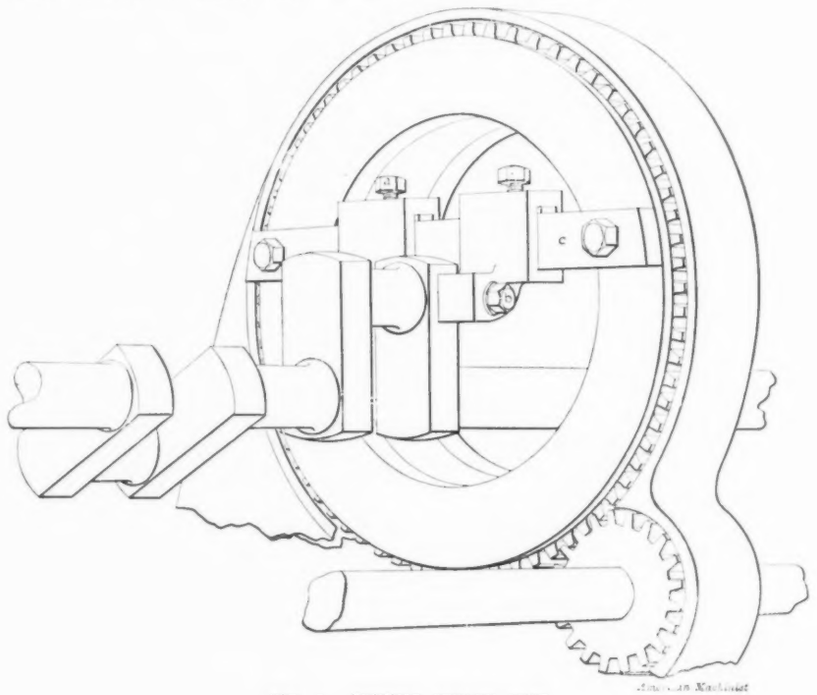


FIG. 2. DRIVING STEADY REST.

The lathe and work have been adjusted to bring the crankpin next the steady rest in line with the face-plate centers and the chuck jaws grip the work where they will do the most good. When the jaws are adjusted to the work, the set-screws *a a* are loosened and the bolt *b* tightened. The set-screws being loosened, the jaws adjust themselves on the bar *c* to suit the inequalities of the forging, and after the tightening of bolt *b* the set-screws are tightened, insuring positive support of the work as well as a driving effort at the nearest possible point to the cut.

To provide for the adjustment of the shaft to insure correctness of throw of the crankpins and of their angular spac-

ing, the face-plates are fitted with adjustable slides and swivels shown in Fig. 3. To adjust for the throw the slide *a* is slid across the plate by a screw *b*, the eccentricity being read from graduated scales and confirmed by dowel pins fitting corresponding holes shown in slides and face-plates. The throw being properly adjusted, the various crankpins are brought successively in line with the center line of the face-plates by revolving the swivel *c*, which is graduated in degrees and, like the slide, is fitted with dowel pins and holes to confirm the reading of the graduated circles. In order to insure that the angular adjustment of the swivel shall be carried to the work, it is essential that no back-lash exists, and to insure this the clamp or caliper dog *d* is provided, which grips the shaft and connects it mechanically with the face-plate.

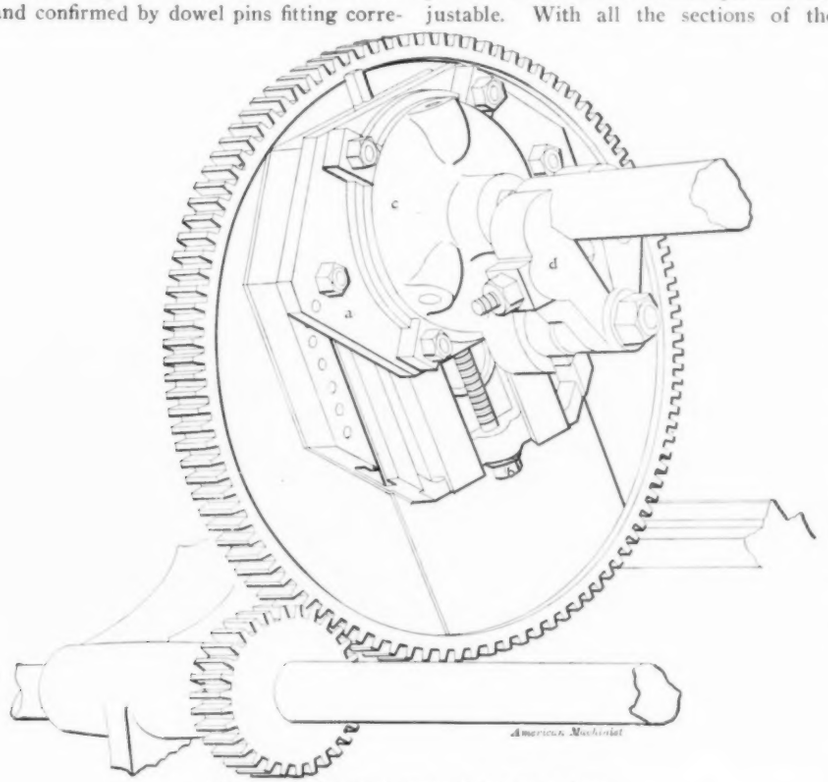


FIG. 3. FACE-PLATE WITH SLIDE AND SWIVEL.

To provide the necessary support of the tool, which must naturally project considerably in most cases, the tool block shown in Fig. 4 is furnished. This block swivels at the joint *a*, and either front or rear side may be presented to the work. The rear side, as shown, has a narrow projecting wing *b*, which has a second tool-post, and, being narrow, may enter the space between the crank cheeks and support the tool nearly to its point. For small shafts having insufficient room between the crank cheeks for this wing, the tool-post is turned to the position shown in the illustration, and an adjustable support *c* is used to take the pressure of the cut.

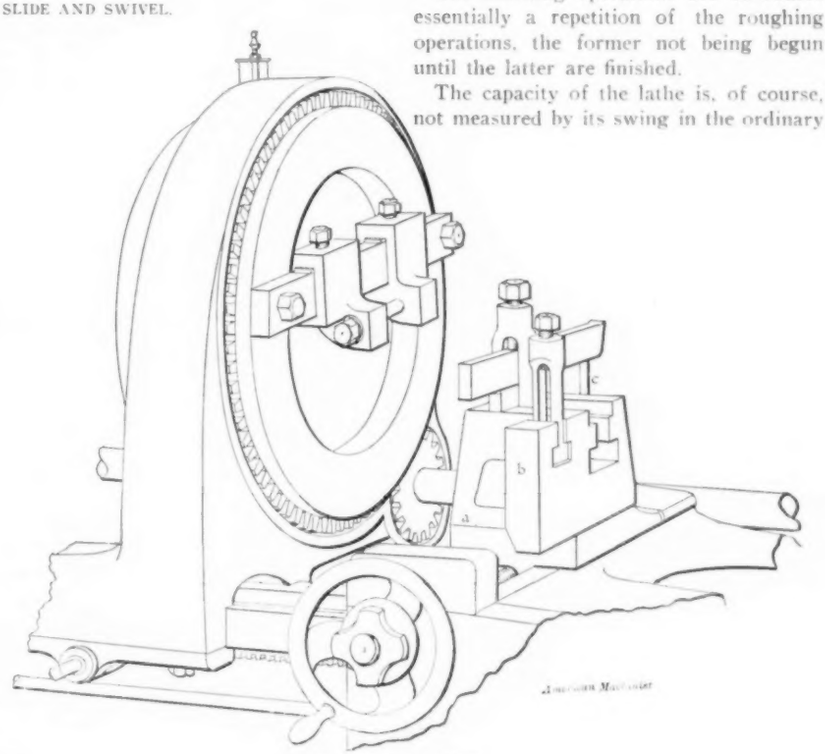


FIG. 4. TOOL BLOCK.

With the shaft set in the eccentric position for turning the pins, its effect is of course to throw the lathe out of balance. To correct this, which is essential for the finishing operations, balance weights, shown at the tailstock end of Fig. 1, are placed on the rear sides of both face-plates. These are both multiple and adjustable. With all the sections of the weights in the most extreme eccentric position they are sufficient to balance the heaviest shaft for which the lathe is adapted, and by removing some of the sections and reducing the eccentricity the smaller shafts are provided for. The eccentric adjustment is by a screw, and is quickly made. Provision is made for slipping the driving pinions out of mesh in order that the work may be free and the weights adjusted until accurate balance is obtained.

In turning a shaft, the face-plate slides are first adjusted to the required throw, the work is inserted, one pin is brought to the center line of the lathe, the clamp dog is tightened, the driving steady rest is adjusted to the crank cheek nearest the headstock and the left-hand pin is turned. This completed, the steady rest is loosened and moved to the next crank cheek—the jaw carrying cross-bar *a*, Fig. 2, being removed if necessary. Without disturbing the clamp dog the face-plate swivels are turned to swing the next pin into the center line, the steady rest is adjusted to the second crank cheek and the second pin is turned. Proceeding in this way until all the pins are turned, the face-plate slide is adjusted to bring the body of the shaft into line, the dogs are removed and the journals are turned, the steady rest being adjusted as before to bring the driving effort near the part being turned. It is obvious that by adjusting the face-plate slides to half the throw of the pins, the ends of the crank cheeks may be turned and, except for the planing of the sides of the cranks, the shaft be completed before leaving the lathe.

The finishing operations are of course essentially a repetition of the roughing operations, the former not being begun until the latter are finished.

The capacity of the lathe is, of course, not measured by its swing in the ordinary usage of that term. The size designating dimension is the diameter of the opening of the steady rest. Four sizes are made, called respectively the 12-, 17-, 28- and 45-inch machines. The capacities range from

4½-inch single-throw and 2½-inch triple-throw shafts in the first up to 16-inch single-throw, 9-inch triple-throw and 15-inch double-throw locomotive crank axles in the last.

Gages.

BY JOSEPH M. STABEL.

Nowadays when a piece of mechanism or a machine is perfected and ready for manufacturing, the first thing to be considered is the making of the gages, which is ofttimes a very expensive item, especially when the mechanism is of an intricate nature. To obviate errors in the gage making is a very essential point in this class of work, as an error in one gage may affect the accuracy of others, or, in other words, this incorrect gage may be used as a master to make others to, they in turn being used on different parts of the mechanism; thus the error may be multiplied a number of times before being detected, and when at last found it is oftentimes a difficult matter to correct it, as it may be that that same error has by that time established a size of its own to which many other gages have been made, and to rectify it may mean the overthrowing of all the gages that have followed the making of the first incorrect one. So it is obvious that the greatest foresight and skill must be exercised when making the masters. It happens many times that a man is given a gage to make, with orders to get it as nearly correct as he possibly can: the tool may be nothing more than a distance gage for locating one hole from another and, moreover, it may be that the second hole is only a screw or clearance hole. The toolmaker criticises the foreman's orders for requiring unnecessary exactness, but the foreman knows why he gave those orders. He sees, perhaps, that he must use that second hole as a gaging point to locate another or third point from, as the gaging of this from the first hole would require an unpractical gage; or there may be some obstruction in the way, so that he cannot avoid measuring from the second hole. I do not advocate, nor is it advisable to use, more than one point on a job to gage from, but oftentimes it cannot be avoided.

I wish to mention right here a point which has often been brought to my notice, and which, while having nothing to do with their accuracy, does concern the construction of all classes of limit gages. Take, for instance, the ring gage shown in Fig. 1, having two hardened and lapped bushings—one in each end of the large knurled ring which acts as a holder: there is a difference of .001 inch in the inside diameter of these rings, or .0005 inch limit each way from standard size. The knurled ring is marked with the respective sizes, and on the ends are stamped "Go" and "Not go." Now, these little words tell at a glance which way the gage is to be turned, but I think the words are not sufficient. A man working on a machine picks up that gage and uses it, perhaps, many hundred times a day, and without taking the trouble to look at the lettering, he will try it on the work, turning it end for end, may be, to find that neither end will go on the work. Now if that same gage was made, as in Fig. 2, so that the large end marked "Go" was distinguishable in form from the small end, the man manipulating the gage would, when picking it up, naturally turn it so the big end could be tried first; if that would not go on he would know it would be useless to try the other side. I have been requested by several men to chamfer one of the edges of such ring gages for just that reason. There are some limit gages made as shown in Figs. 3 and 4, and on such it is not necessary to follow the above practice, as their position need not be changed to discern the respective sizes.

Fig. 5 shows a small combination bench gage used for testing the diameter of a ball, also at the same setting, showing if the hole through the ball is concentric with its outer diameter; this last-named operation is accomplished by a lever, the end nearest the fulcrum being hardened, ground and lapped to fit the hole in the ball, while the other end multiplies any eccentricity of the hole, the ball itself being held central by a snap gage fastened on the main plate.

Pin gages are made in many different forms and are often used as limit gages. They are employed mainly in gaging surfaces that are obscure—say, at or near the bottom of a hole. Fig. 6 shows such a gage constructed for determining the depth of a hole. It is composed of two plates *a* and *b*, which are cut away so that they will have a three-point bearing in the hole;

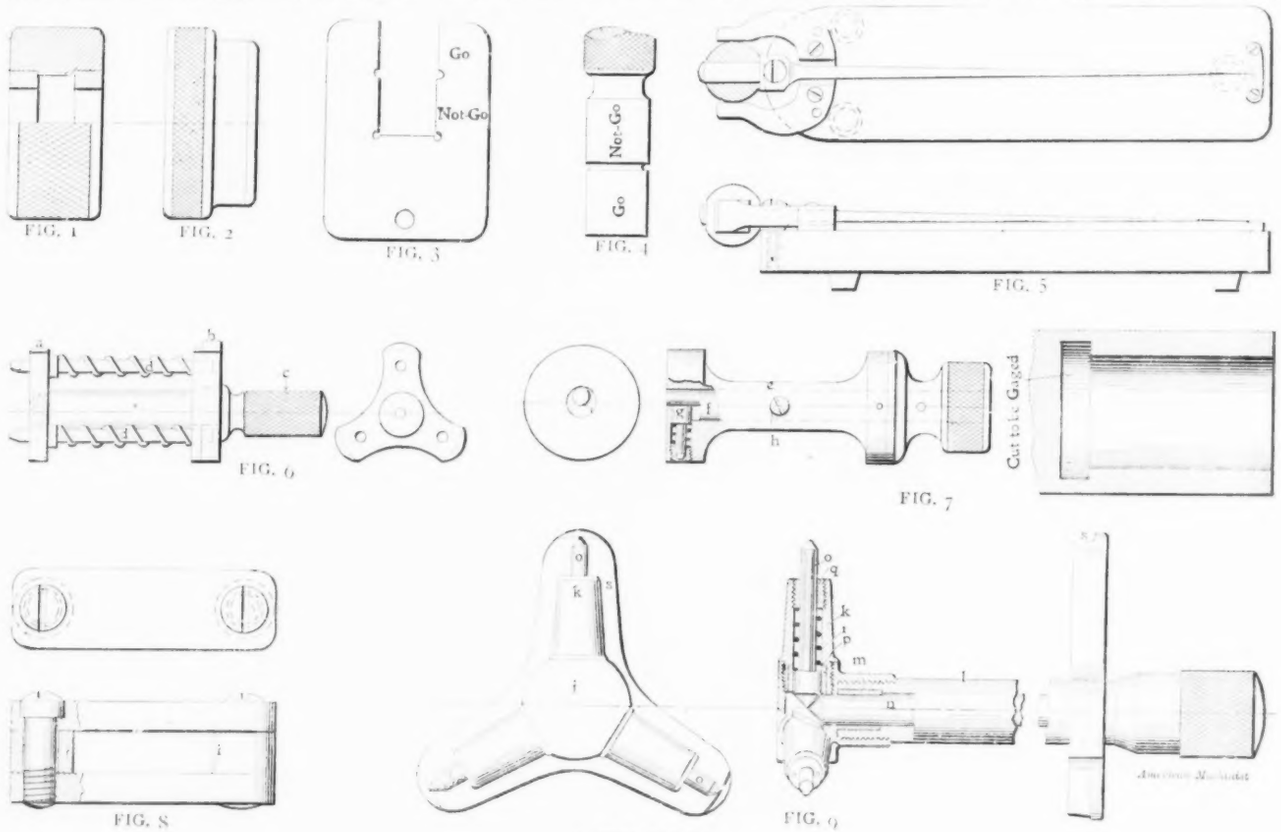


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9

A FEW GAGES.

both are hardened and ground, and plate *a* has a tapped hole through its center into which the handle *c* screws, plate *b* also having through its center a hole in which the handle is a press fit, this handle holding both plates in alinement. The three pins *d* are hardened and lapped at both ends, and there is a small collar on each against which the springs act, giving them a downward pressure. The plate *b* has its outer diameter turned and ground so that it fits for about one-third of its width into the hole, while the remaining part rests on top of the work. The top face of *b* is lapped to a level surface. When the gage is placed in the hole to be tested, the lower ends of the pins come in contact with the bottom of the hole, and by a little pressure on the handle the upper plate is then forced down to its seat on the work, the pins projecting through the holes in this plate, unless the hole is of proper depth, when the tops of the pins must be perfectly level with the top face of *b*.

Fig. 7 shows another style of pin gage, this one being constructed for gaging the recess shown in the accompanying piece of work. It is composed of the body *e*, which is hardened, ground and lapped on its two flanges and has a straight hole through its center, also lapped out, to receive the hardened and ground plug *f*, which in turn has an eccentric ground on one of its ends, this operating the gaging pin *g* which is held against the eccentric by a small spring. The small screw *h* engages in a slot milled into *f* and allows the latter to make a half turn. Secured on the end of *f* is a knurled head, one end of which is turned to form a flange whose diameter coincides with the end of *e;* on these two flanges are zero, or limit lines, as the case may be. The location of these lines is governed by the length of pin *g*, the depth of the cut to be gaged, and the throw of the eccentric.

Fig. 8 shows a very simple gage which has several advantages, one of these being that the original size can never be lost. The two collars *i i* are hardened, ground and lapped to the required thickness, thus the size of the gage is established and can be maintained with very little trouble. On these two collars are held two plates of hardened steel, one side of each being ground and lapped and this side resting on the collars. To compensate for wear the hardened plates are removed and relapped, so that they will be perfectly straight, and then replaced without in any way affecting the gage size.

In conclusion, I shall endeavor to show a gage that is extensively used for testing the size and parallelism of a hole, and mainly adapted for holes that are at least 3 inches in diameter and of unusual length. Its construction is as follows: Part *j*, Fig. 9, is a head into which screw the three sleeves *k* and the tube *l*. The latter is a piece of seamless steel tubing carefully straightened and with one end bored out to receive the hardened and lapped bushing *m* and the other end bored to receive the micrometer nut; on this end are located also graduations similar to those on a micrometer. One end of rod *n* acts as the micrometer screw, while the other end is hardened and ground and lapped to a running fit in bushing *m;* this same end is ground and lapped off to a perfect 45-degree cone which acts on similar ends on parts *o*, serving as the measuring rods, these being hardened, ground and lapped and the largest diameter fitting in the hardened and lapped bushing *p*, while the smaller part slides through the nut *q*. The springs *r* tend always to hold rods *o* against *n*, and part *s* serves to hold the micrometer end of the gage in alinement, it being a sliding fit on tube *l*.

An Ideal Course for an Engineering Student.

We take the following from an able and interesting paper—too long for us to reproduce in full—in the *Sibley Journal of Mechanical Engineering*, by Prof. William Kent, Dean of the Smith College of Applied Science, Syracuse University:

If I were to plan a course of preparatory instruction leading to a student's entering an engineering college at the age of nineteen and graduating at twenty-three with the degree of civil, mechanical or electrical engineer, I would give him as broad a training as possible in the preparatory school, qualifying him to enter either the philosophical or the scientific course of the liberal arts college of the university at seventeen years of age. I would then send him, not to the liberal arts college, but into a machine shop, where he would have to work ten hours a day for one year. Here he would get a taste of the kind of experience which every engineer must get, sooner or later. He would get there some knowledge of the world of industry, of the methods of handling men, of the value of time. He would learn there that engineering is not only the science and art of utilizing the forces of nature for the benefit of man, as Tredgold defined it, but also that it is the art of overcoming the resistances of nature—including human nature. He would learn something of the kinds of human nature with which he will have to deal in later life. He would get physical and mental strength. Above all, he would "find himself," as Kipling expresses it, and learn whether or not he had made a mistake in deciding to become an engineer. If all candidates for entrance into Sibley College were compelled to take this preliminary year in the shop, perhaps 10 or 20 per cent. of them would discover before the year ended that they were not adapted to become engineers, a fact which, without the shop training, they might not discover until after they had graduated from the college and entered practical life. This shop training, for the 80 or 90 per cent. who find by it that they have the natural capacity to become engineers, would be of great value to them in their subsequent college course. It has been the general experience of teachers of engineering that those boys who have had some experience in a shop make the best engineering students.

After the year of the machine shop, the student should enter the college of liberal arts for one year, and here he should first correct the defects of his training in English in the preparatory school by learning how to spell and how to write in a passable handwriting a good English composition without glaring errors of grammar and rhetoric. Here also he should study physics, chemistry, mathematics and the German language. Then he would be ready to enter the college of engineering.

There is a broad distinction between the student who takes the four years' course in the liberal arts college for any purpose whatever, and the one who, without that course, takes the four years' course in a college of engineering.

The former student enters the four years' course in liberal arts with the intention of taking a course of study that will give him a broad, general culture and fit him at the end of four years, not to begin to earn his own living at, say, twenty-two or twenty-three years of age, but to begin three years more of study which will lead to his becoming a minister, a doctor, a lawyer, an artist, a teacher or a man of business. In the liberal arts college he obtains no special knowledge which fits him to enter at once on any business or profession. He may enter with "little Latin and less Greek," perhaps no French or German, a smattering of mathematics, a knowledge of some English literature, but not such a command of the language as will enable him to write a presentable essay. In his course through the college, with our modern fashion of electives, he may dawdle away a large part of his time or spend it on subjects which will be of little benefit to him. He has plenty of time for athletics, he may obtain a good general culture, a good physique, good social qualities, and be an all-around good fellow, but it will take some years of further study or practical training before he is fitted to earn a living, which he may be able to do when he is twenty-six or twenty-seven years of age.

The case of the average student of a college of engineering is entirely different. His entrance requirements are in some respects higher. He must be better equipped in mathematics than the student who enters the liberal arts college. He must know something of either German or French, and of physical science.

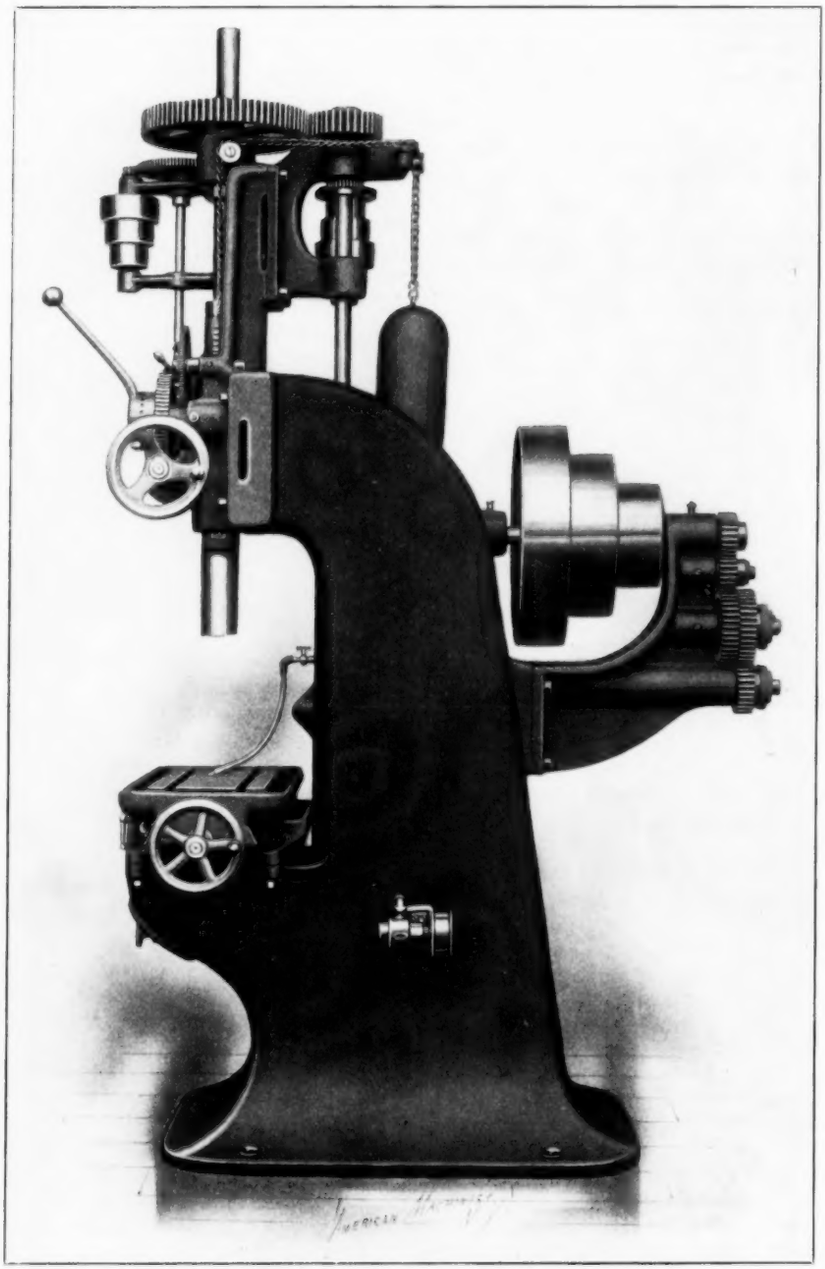
The object of the four years' course is not merely to give him as broad a general culture as the time will admit, but also to develop his brain in a certain direction, that of solving difficult mathematical problems, and also, and chiefly, to give him that special knowledge of engineering theory and practice which will enable him to enter at once, after graduation, upon

the practice of his profession, and to earn money—say, $50 per month at the start. The college of engineering thus really attempts to crowd into four years the education which in other professions requires seven years. Of course it can only be done, first, by leaving out some of the culture studies which are preliminary to the other professional courses; second, by cutting down some of the time which the student in liberal arts gives to athletics and to society; third, by the most intense study and work during longer hours than those of the academic course.

In this attempt, however, the engineering colleges of this country during the last thirty years have been eminently successful. They have turned out some thousands of young men, a large part of whom are now captains of industry, leaders of great enterprises, successful men in every sense of the word; men of broad culture and refinement, leaders of thought, in science, in business, and even in politics.

The essential condition of success of such men is that they throw away childish things early in their freshman year, and buckle down to four years of intense hard work. Many of them work in shops during their vacations, and therein gain experience which helps them in their studies. A few, a very few of them, become famous in athletic contests, but they are exceptional men who come to the college endowed with active brains and sound bodies, but the average man in the engineering school, if he would keep up with his class in professional study, can find no time for any more athletics than the necessary amount to keep him in good health. So, also, the engineering student can have but little time for social pleasures. The average student, in order to graduate, must make up his mind to spend at least nine or ten hours a day in study, in work in the shops, drawing rooms and laboratories and in the lecture and recitation rooms.

Many young men make a mistake in coming to an engineering college, and they don't find it out until well along in their course. Many come imperfectly prepared, and their courage in entering handicapped with conditions is more commendable than their judgment. But to the student who, whether entering with conditions or not, begins his work with a sound body and a sound mind, with an honest intention to do his utmost to succeed, with a willingness to forego, if necessary, the prizes of athletics and the pleasure of society, in order to get the time that is required for study, I have to offer the heartiest encouragement.



SPECIAL DRILL TESTING MACHINE.

Power Absorbed in Drilling in Various Metals at Various Speeds and Feeds.

BY H. M. NORRIS.

There was given at page 1334, Vol. 25, a series of "Electrical Tests of Power Required for Drilling Cast Iron from the Solid."

These tests were made by the Bickford Drill & Tool Company, Cincinnati, Ohio, on one of its 4-foot standard radial drills,

Revolutions per Minute.			Feed in Thousandths per Revolution.	
30.90	64.53	134 73	3.39	11.42
32.91	68.73	143 50	3.76	12.66
35.04	73.16	152.75	4.16	14.02
37.28	77.84	162.54	4.61	15.49
39.65	82.80	172.89	5.10	17.18
42.11	88.06	183.88	5.65	19.05
44.85	93.65	195.55	6.26	21.09
47.70	99 60	207.98	6.93	23.30
50.74	105.95	221.23	7.67	25.84
53 99	112.74	238 50	8.50	28.65
57.83	120.01	250.49	9.42	31.72
61.21	127.81	266.84	10.42	35.04

TABLE I—SPEEDS AND FEEDS WITH WHICH MACHINE IS PROVIDED.

since which time it has designed and built for the Morse Twist Drill & Machine Company, New Bedford, Mass., the special drill testing machine shown in the accompanying half-tone engraving.

The demand for such a tool was created by certain users of drills specifying the speed and feed under which they wished to operate them, and inasmuch as no two users appear to hold the same opinion as to what combination of speed and feed produces the best results, the Morse Twist Drill & Machine Company determined to install a machine in which drills could be tested under approximately any speed or feed that might be specified.

As the requisites of such a machine included an elimination of all spring in the frame, a minimum number of transmission gears, an absence of clutches of any kind, great driving power and a large number of speed and feed changes, it made an

ideal tool with which to determine the power absorbed in performing work of various kinds. It is thought, therefore, that the appended tables furnish excellent material upon which to base a formula.

The readings were taken by an expert from the Triumph Electric Company, Cincinnati, Ohio, who very kindly furnished the motor and testing instruments, consisting of a Weston 50-ampere meter, a Weston portable voltmeter and a Schaffer & Budenberg hand tachometer, each of which were calibrated previous to using.

The machine was driven from a countershaft belted to a constant-speed motor, the power required to drive which, together with that absorbed by the countershaft and belt, was deducted from each reading. The results given in the tables represent, therefore, the power absorbed by the driven cone, which includes, of course, the power absorbed by both work and friction.

Referring to Table 1 it will be seen that that while the maximum speed of the machine is 8.6 times the minimum speed and the maximum feed 10.3 times the minimum feed, the intervals are very small.

The letters A, B and C which appear in Tables 2 to 5, inclusive, indicate different drills and pieces of metal. For instance, test No. 3A was made with a drill and in a different block of iron than test No. 3B. To make it still plainer: tests 1 to 5, column A, Table 2, were made with the same drill operating in the same piece of iron, and tests 1 to 5, column B, with a different drill in a different piece of iron. Likewise tests 6 to 10, column B, were made with the same drill operating in the same piece of iron, and tests 6 to 10, column C, with a different drill in a different piece of iron, but in the same piece of iron in which tests 1 to 5, column C, were made, as each piece of iron was drilled five times with five sizes of drills.

The only conclusions drawn from these tests to which I am willing at this time to give voice are:

1. When the speed and feed are constant, the power required to drill cast steel is about 1.10 times, wrought iron about 1.65 times and machinery steel about 1.90 times, that required to drill cast iron.

2. When the speeds and feeds remain constant, Table 6, the power required is approximately proportionate to the diameter of the drill.

3 When the diameter of the drill and rate of feed are constant, Table 3, the power required is approximately proportionate to the speed.

4. When the speed and diameter of drill are constant, Table 2, the power required is approximately proportional to the feed.

Note.—In next week's issue we will publish these data in diagrammatic form in the three co-ordinate system which illustrates the various relationships in a very striking manner.—Ed.

Test.	Diam. of Drill.	Revolutions per Minute.	Feed per Revolut'n	Cubic In. Removed per Min.	Power Absorbed in Test. A	B	C	Average Power Absorbed.	H. P. per Cubic In.
1	½	265.8	.0155	.8089	1.84	1.92	1.71	1 82	2.249
2	"	"	.0190	.989	1.92	2.07	1.78	1.92	1.94
3	"	"	.0233	1.197	2.10	2.17	2.02	2.10	1.755
4	"	265.6	.0286	1.491	2.31	2.69	2.36	2.45	1.643
5	"	264.5	.0350	1.818	2.48	3.23	2.69	2.79	1.535
6	¾	179.7	.0155	1.230	1.51	1.75	2.07	1.78	1.447
7	"	179.3	.0190	1.505	1.66	1.98	2.28	1.97	1.309
8	"	178.4	.0233	1.837	1.93	2.11	2.58	2.21	1.203
9	"	178.3	.0286	2.254	2 42	2.68	2.82	2.64	1.170
10	"	175.8	.0350	2.720	2.82	3.18	3.19	3 06	1.125
11	1	125.8	.0155	1.531	1.38	1.57	1.89	1.61	1.052
12	"	125.	.0190	1.865	1.48	1.80	2.17	1 82	976
13	"	124.7	.0233	2.282	1.72	1.98	2.27	1.99	.872
14	"	124.2	.0286	2.790	1.98	2.56	2.61	2.38	.853
15	"	123.4	.0350	3.392	2.41	3.30	2 97	2 89	.852
16	1¼	96.98	.0155	1.844	1.36	1.75	2.10	1.74	.944
17	"	96.42	.0190	2.248	1.56	2.06	2.44	2.02	899
18	"	95.82	.0233	2.739	1.79	2.57	2.61	2.32	.847
19	"	"	.0286	3.363	2.13	3.17	3.51	2.94	.874
20	"	95.14	.0350	4.086	2.90	3.69	3.30	3.30	.808
21	1½	76.20	.0155	2.087	1.42	1.77	1.80	1.66	.796
22	"	75.94	.0190	2.550	1.67	2.04	2.35	2.02	.791
23	"	75.64	.0233	3.114	1.99	2.38	2.90	2.42	.777
24	"	74.66	.0286	3.773	1.92	2.86	3.08	2.62	.694
25	"	74.49	.0350	4.607	2.82	3.42	3.63	3 29	.714

TABLE 2.

Power Absorbed in Drilling Cast Iron under Various Feeds, the Speed Remaining Constant for each Size Drill.

Test	Diam. of Drill.	Revolutions per Minute.	Feed per Revolut'n	Cubic In. Removed per Min.	Power Absorbed in Test. A	B	C	Average Power Absorbed.	H. P. per Cubic In.
26	½	165.5	.0155	.5027	1.25	1.60	1.46	1.44	2.865
27	"	187.7	"	.5702	1.35	1.65	1.49	1.50	2.631
28	"	213.	"	.647	1.45	1.69	1.63	1.59	2.457
29	"	238.	"	.723	1.58	1.76	1 68	1.68	2.324
30	"	268.5	"	.8157	1.79	1.94	1.83	1.85	2 268
31	¾	111.	.0172	.8438	1.05	1.40	1.07	1.18	1.398
32	"	125.	"	.9503	1.06	1.38	1.21	1.22	1.284
33	"	135.	"	1.026	1.51	1.76	1.58	1.62	1.579
34	"	155.	"	1.178	1.74	1.86	1.72	1.78	1.512
35	"	175.9	"	1.337	1.80	2.10	1.81	1.90	1.421
36	1	76.63	.0190	1.144	1.21	1.54	1.10	1.28	1.120
37	"	85 46	"	1.275	1.27	1.69	1.23	1.40	1.098
38	"	96 68	"	1 443	1.30	1.90	1.49	1 56	1.081
39	"	109 6	"	1.636	1.55	1.98	1.59	1.71	1.045
40	"	124 2	"	1.853	1.78	2.09	1.70	1.86	1.004
41	1¼	61.44	.0211	1.591	1.38	1 61	1.29	1.42	.893
42	"	67.11	"	1.737	1.70	1.86	1.60	1.72	.990
43	"	77.05	"	1.995	1.82	2.19	1.75	1.92	.962
44	"	86.18	"	2.231	2.09	3.30	1.90	2.10	.941
45	"	97.40	"	2.522	2.32	2.49	2.09	2.30	.912
46	1½	46.76	.0233	1.925	1.72	1.59	1.52	1.61	.836
47	"	53.16	"	2.189	1.84	1.78	1.66	1.76	.804
48	"	60.41	"	2.487	2.11	2.05	2.00	2 05	.824
49	"	67.11	"	2.763	2.44	2.38	2.15	2.32	.840
50	"	75.94	"	3.127	2.65	2.67	2.38	2.54	.812

TABLE 3.

Power Absorbed in Drilling Cast Iron under Various Speeds, the Feed Remaining Constant for each Size Drill.

Echoes From the Oil Country — The Men We Hire And The Men We Don't Hire.

BY W. OSBORNE.

"Business is beginning to pick up some and it looks as though we might be able to work a few more men. Do you know of any that would suit?" The superintendent is talking to one of his men.

"There are lots of men not working and that would be glad to get in here, but when it comes to recommending them as being the kind that would suit here, that is a different thing. If I run across any I will let you know. There is a man up by

the door that looks as if he was looking for you." And the man goes on with his work while the superintendent walks up front.

"Say, you are the boss here, haint you?" A nodded assent is the answer. "I came in to see if I could not get a situation with you. You see, I have a family to support and they need all that I can earn. It takes a lot of money to pay rent."

"What can you do around a machine shop?"

"I'm not a machinist or anything of that kind, but I am willing to do anything you put me at. You see, I am somewhat behind and I need a job very bad. I will take anything for a little while until I can get something better. When would you like to have me come in?"

"Did you ever work around a machine shop or around machinery?"

"No, not exactly; but you see I am quick to pick up anything, and besides that I need work. You see, I need the money. I am hard up, I tell you, and have a family to keep. My wife is not very well, and there are several little children that need clothes. Will I come in in the morning?"

"I am sorry that you are not available for anything that I have to do."

"But I must go to work somewhere. I have a wife and several small——"

"Excuse me. There is another man that wants to see me."

"Hello! boss. I am looking for a job. I have been working up at the stone quarry for about four years, and now they have quit running it and I have to get some other job. Can't you find something for a good fellow that wants work?"

"What can you do around a machine shop?"

"I don't know much about a machine shop, as I never worked in one, but I am willing to do my best at anything you care to try me at, and you can be sure of me being on hand for business as long as I work for you. If you can start me in, you can see whether I can suit you or not. Just try me and pay what you find I am worth, and if I am not suited I will hunt for another job. If I can't suit you, throw me out. You will be the first man that wanted to do that after I got started, though."

"I suppose you would have to get drunk once in a while?"

"I couldn't afford to if I wanted to. I have a wife and a lot of little children that need all that I am likely to be worth to you or anyone else. All I ask is a chance to show you whether I can suit you or not. If I can't, let me go and there won't be any hard feelings on my part. I'll go and try to find someone that I can suit. No use trying to work for a man if you can't do his work."

"That sounds fair enough, and if it's work that you are really looking for we will soon find it out. That is the only thing we hire a man for. Come in in the morning at 7 o'clock."

"I wonder if the man that has just stepped in wants to buy something, or whether he is a drummer, or what? I will go and see.

"Was there something that we could do for you?"

"Yes. I am looking for a situation. I am a machinist. I know some of the best people in this part of the country. You know Mr. Smith, of course. The Mr. Smith that is in the bank. I just returned from a hunting trip with him. There is Mr. Jones that has the dry goods store; we play golf together a great deal. He is a great friend of mine. He would do anything in the world for me. I often go up to Mr. Brown's house. He is never satisfied when he meets me unless I promise to spend the evening with him."

"What line of work are you the best on?"

"Put me anywhere you see fit to. It is all the same to me. I am as good one place

Test.	Diam. of Drill.	Revolutions per Minute.	Feed per Revolution	Cubic Inches Removed per Minute.	Power Absorbed in Test. A	B	C	Average Power Absorbed.
51	1	84.61	.02109	1.3889	1.566	1.358	1.729	1.551
52	"	93.99	.01905	1.4067	1.494	1.258	1.639	1.464
53	"	102.40	.01748	1.4058	1.566	1.303	1.578	1.482
54	"	115.63	.01549	1.4067	1.691	1.318	1.681	1.563
55	"	131.41	.01402	1.4470	1.753	1.332	1.756	1.614

TABLE 4.

Power Absorbed in Drilling Cast Iron under Various Speeds and Feeds, the Cubic Inches of Metal Removed per minute Remaining Practically Constant.

Test.	Diam. of Drill.	Revolutions per Minute.	Feed per Revolut'n	Cubic In. Removed per Min.	Material.	Power Absorbed in Test. A	B	C	Average Power Absorbed.	H. P. per Cubic In.
56	½	185.9	.0114	.418	C. I.	1.20	1.36	1.36	1.31	3.133
57	"	189.9	"	.425	C. S.	1.46	1.41	1.49	1.45	3.411
58	"	192.4	"	.4306	W. I.	1.86	1.90	1.88	1.88	4 366
59	"	190 5	"	.4264	M. S.	1.82	1.84	1.88	1.85	4.338
60										
61	¾	123.1	.0104	.5655	C. I.	.81	.89	.90	.87	1.538
62	"	125.	"	.574	C. S.	1.05	1.05	.99	1.03	1.794
63	"	126.8	"	.5825	W. I.	1.59	1.42	1.37	1.46	2.506
64	"	127.7	"	.5867	M. S.	1.61	1.64	1.58	1.61	2.744
65										
66	1	86.18	.0094	.636	C. I.	.92	.89	.89	.90	1.415
67	"	85.76	"	.633	C. S.	.93	1.04	.98	.98	1.548
68	"	87.46	"	.6456	W. I.	1.36	1.33	1.41	1.37	2.122
69	"	85.88	"	.634	M. S.	1.48	1.46	1.28	1 41	2.223
70										
71	1¼	65.1	.0085	.679	C. I.	.67	.67	.70	.68	1.001
72	"	64.85	"	.676	C. S.	.74	.70	.70	.71	1.050
73	"	65.7	"	.685	W. I.	1.17	1.27	1.00	1.15	1.678
74	"	65.4	"	.682	M. S.	1 33	1.39	1.32	1.35	1.979
75										
76	1½	51.02	.0077	.694	C. I.	.68	.81	.78	.76	1.095
77	"	50.34	"	.6849	C. S.	.78	.87	.76	.80	1.168
78	"	51.32	"	.698	W. I.	1.36	1.22	1.14	1.24	1.776
79	"	51.2	"	.6966	M. S.	1.35	1.35	1.53	1.41	2.024
80										

TABLE 5.

Power Absorbed in Drilling Various Metals, the Feeds and Speeds Remaining Constant for each Size Drill.

Test.	Diam. of Drill.	Revolutions per Minute.	Feed per Revolution.	Cubic Inches Removed per Minute.	Power Absorbed in Test. A	B	C	Average Power Absorbed.
1	½	183.3	.01549	.558	.891	.727	.848	.822
2	¾	181.3	"	1.239	1.068	.906	1.037	1.004
3	1	181.	"	2.202	1.522	1.421	1.449	1.464
4	1¼	180.	"	3.422	1.887	1.521	1.871	1.76
5	1½	180.	"	4.927	2.171	1.916	2.341	2.143

TABLE 6.

Power Absorbed by Different Sizes of Drills under the Same Speed and Feed.

as I am another. Mr. Davis—of course you know Mr. Davis, everybody knows him. He has been a lawyer here all his life. Mr. Davis said he knew you would be glad to get a good man at any time. We were up Stewart Run trout fishing just before the season closed. He carries the best liquor that I ever got on such a trip, and always used me like a brother. He knows my good points, knows them like a book. Ask him anything you want to know about me. He will only tell you what is right."

"You seem to be a man of quite varied attainments, but I do not know of anything that I can use you at at present."

"I am sorry to hear that, as you are missing the chance of a lifetime. I took the prize for waltzing at the firemen's picnic last month—but good day, sir; good day." And my caller of many attainments is gone.

Mr. Davis has the name of being a very good lawyer. He has been a friend of mine to some extent for years, and I am always glad to see him even if it is my busy day. I don't think that he is in need of anything in my line, but perhaps he knows of someone that does and is going to give me a tip. "How d'you do, and what is the good word with you to-day?"

"Everything is going well. I just dropped in to speak to you about a man that is looking for work. He goes to our church and is a real nice gentleman; so nice and polite, you know, and then he is such a nice singer. He has a class in the Sunday school, and is a great hand at the socials."

"He must be a clever fellow. What does he know about a machine shop?"

"Now, I really don't know. I never thought to ask him anything about that, but he is intelligent and would do anything you asked him to. Of course I would not want you to put him at real hard or dirty work, such as that man is doing." (One of the best machinists is at a repair job near us and has passed through the range of Mr. Davis's vision several times, and evidently impresses him to some extent.) "He would be a very nice man to have around where he could meet those that came in to do business with—with the shop." A bright idea has evidently struck my friend, but he is a little modest about advancing it.

"If *you* could only provide him with employment for a little while I might see what I could be able to find for him by and by," I said.

"Oh, I haven't anything that I could possibly put him at. They all have to be experts around a lawyer's office."

"I didn't know but that you could have him write up deeds or other such papers, as all he would have to do would be to have to follow the proper forms, and—say, I'll tell you what you might have him do. No doubt you often get a call from a client to go to him when you cannot possibly go at once; now why wouldn't it be a good idea to have this man handy so that you could send him to entertain your client until you can get there? I don't sup——"

"Mr. Osborne, you may be a good enough sort of a mechanic, but I see that you utterly fail to comprehend the importance of the work that a lawyer has to do. It is not often that I go out of my way to ask a little favor of a friend, and I see that I have made a mistake in thinking that you would give a request from me consideration. I will not take up any more of your time, as I have important matters to see to. Good day." And he departs with a show of dignified grandeur that would not look well on a man with overalls and with a streak of smut across his face.

Mr. Williamson is a fine man and one that is always trying to help people along, and no doubt he is on such an errand now as he comes in. "You don't use much machinery, but I am always glad to see you. You are looking hearty."

"I am feeling first rate, too. I came in for information. You know that I often try to help people get work. I believe in making folks earn their way in the world. There is a young fellow that says he is looking for work; that he has looked all over town and cannot get a start anywhere; that he has been here a number of times, and that you have turned him down without even listening to what he had to say. His name is —— ——. Do you know him?"

"He was raised right here on this street."

"He looks like a strong, active, intelligent young fellow. Why don't you put him to work? What is wrong with him?"

"The trouble is that he is too well known. He had better go off to some place where he is a stranger. He was the meanest little boy around here. His play seemed to be to make some other child miserable. I wouldn't have him in the shop under any consideration."

"Don't you think that there is some good in him that is worth trying to bring out?"

"Do you think that I am running a reformatory as well as a machine shop? Don't you think that it is due to the workmen that I already have that I hire decent people to work in the shop with them? Don't you think that there is a lot of sentimental foolishness talked about helping folks that don't want to be anything, and giving them places that should be given to the good, willing material that does want to be something? Don't you think that the owners of the shop and the general public that have to use the product of it deserve some consideration? Don't you know that a good name is an asset in this business the same as in any other, and do you want to lower the value of that asset to help some worthless one whose only claim is that he is so mean and good-for-nothing that he can't find anyone that will endure him? The only thing that will get a man a job in this shop is the belief that he would make a good hand for us, and the only way he can keep it is by showing that the belief is well founded."

"It may be a good thing that all the world is not as hard hearted as you make out yourself to be."

"I suppose, Mr. Williamson, that you and the rest of the men in the office where you are an accountant were chosen because of your necessities and not because you were good accountants?"

Mr. Williamson flushed at this stab. "I think that the comparison is hardly a fair one, but I would like to know what qualifications you do look for in a man."

"I will tell you a couple of stories, and then you can judge for yourself. Once a young mechanic took charge of a shop as foreman. He had been raised among job work, and this was a job shop. The men were strangers to him, and he did not know their capacities and limitations, and so was very careful in giving orders. One day a man, after having received careful directions as to what to do, and how to do it, disregarded what he had been told and spoiled the job, and by so doing brought the fact that he had not followed directions to the attention of the foreman. He lost his job. Soon his wife, a very fine little lady, by the way, came down and called on the owner of the shop. Tears ran from her eyes and sobs shook her frame. There was a little home being bought, there was a family of small children, there had been sickness. The owner of the shop went out and told the foreman that the man would be in the next morning to resume work. The foreman promptly tendered his resignation, to go into effect not later than quitting time that night. The owner tried to have him see the matter in a reasonable light. 'There is no use of talking. The only way that man can ever work for me again is for him to come and say he is willing, to the best of his ability, to obey every order that he receives, and then he could only stay as long as he showed that he was trying to do as he said.'

"'What would you have me tell his wife, who is in there?' nodding toward the office.

"'Tell her you have a cold, heartless piece of machinery for a foreman, and that he has no human feelings or sympathies, except for the shop and the work; that he figures the work out in a cold-blooded way and forgets that there is anything else in the world; or tell her anything else you see fit to, but don't tell her that you have a fool that doesn't understand the first fundamental principle of running a shop.'

"That man did not come back to work.

"In another case the owner chanced to notice a man that the foreman had hired some time before. 'Say, there is a man you had better get rid of. You could not have known him or you would never have hired him. He is just about as tough a specimen as the town has in it, or used to

be.' The foreman smiled, as he answered. 'I think that I know all about him, and I have not the least fear that his wings are apt to sprout; but if you will look over his time-slip you will find that he is doing a good, honest day's work. You have never seen him do anything out of the way in the shop. He does not interfere in any way with any of the men in the shop, and he is here every day. What more do you want? I have had a number of people stop me on the street to tell me what a bad man he is, and some of them were rather indignant that I should keep him, after refusing to give work to some that they had mentioned. This man came to look for a job for himself, and after a very plain talk with him I was convinced that *he* really wanted it, and that his bad points would not necessarily interfere with the shop. I would be willing to do a little trading to get a few more like him, and will be glad to keep him as long as he keeps on as he has been doing.'

"'You are running things in here, and are to be held responsible,' and the owner walked away.

"That man worked in the shop for several years, and finally left the town to take charge of a line of work in another shop. He was better off financially, and stood better in the community than he had before, and yet this shop was not being run as a reformatory, and I never have run a charitable institution either. Every man that I have working for me can look me full in the face and feel that he is giving value for every cent that he receives, and whenever he believes that he is worth more to someone else he can quit, and he still has my friendship and good wishes.

"This may not be answering your question very fully as to what qualifications we look for in men, and I will say further: A man must be willing, or he has to have a driver over him all the time, and that doesn't pay. A man must be reasonably honorable, or his work is not to be depended on. A man must be peaceable, or there is trouble with his fellow workmen. A man must be intelligent, or it costs too much to get an idea into his head. A man must have an amount of persistence and tenacity, or he will not become proficient in his work, and will not stay long in one shop. A man must have common sense enough to be reasonable and to adjust himself to his surroundings. A man must have a good opinion of the shop. I would not expect good results from a man that thought he was lowering himself by working for me. These are some of the things, besides the one that he must be able to do that which we hire him to do, and I think, Mr. Williamson, it will give you a general idea as to what kind of material it is safe to send our way."

Mr. Williamson smiled good naturedly. "I never supposed that it was such serious business to have the responsibilities of a machine shop on one's shoulders."

"There is responsibility enough as it is, but it would be something awful if a man had to try to get out work with every Tom, Dick and Harry that others tried to unload on him. We are turning away men every day, and yet one of the hard things about the job is to find men suited to the work when we do need them."

"I wonder if everyone that I have gone to trying to get work for someone has looked at the matter in the same light," said Mr. Williamson, half to himself. "I must confess that the number that have been given work is very small compared with the number that I have spoken for."

"I think that you will find that most people have quite a good idea of the ability required for their own calling, and that very few of us appreciate the fine points of the work of the rest of the world, except in a few callings where the difficulties have been so advertised that they are apt to be over estimated. You have no doubt heard of the man who was sweeping over on First sreet. Said he: 'Some people don't realize the skill needed to do a good job of work on the street. They want to put any sort of a person at it. Lots of them that have a sort of fitness for it never get up to where they are fit to be put on a street like this one, but are only fit for the side streets. And very few can do the really fine work that has to be done. Now, there is Bill over there. Bill is a good man at straight, plain work. He can finish around a corner or up along a curb with anybody, but when it comes to doing a nice job of sweeping around a lamp post it takes a man of taste and experience, like myself, to do it so that it is a credit to the city.' He might make a good man for the shop."

Some of my friends think that there are wheels around our establishment that are not in the machines.

Influence of Automobiles Upon Country Life.

One of the points of interest in the motor-car or automobile development is the fact that there is a tendency by people who have fine country houses for sale to advertise them in first-class motor-car journals, the increase of these advertisements indicating not only that the class of periodicals mentioned may become the natural medium for such advertisements, but that the facilities offered by up-to-date automobiles for traveling long distances quickly and easily and without regard to fixed time-tables, increasing the radius of a neighborhood and possibilities of combining with country life a command of city conveniences through accessibility to them, are making country houses more valuable.—*Marshal Halstead, U. S. Consul, Birmingham, England.*

(171) A device is wanted for turning radially, concave and convex, from ½ inch to 2 inches. Preferably a device that can be clamped to the bed of a lathe or screw machine.

Letters From Practical Men.

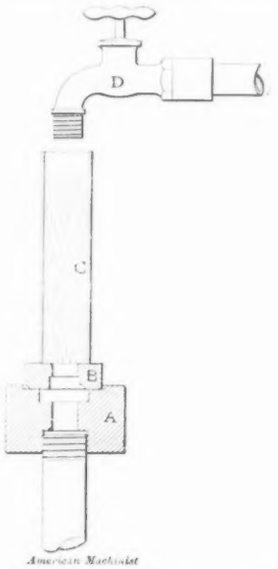
Hardening Dies—Draftsmen as Time Savers.

Editor American Machinist:

The sketch shows an arrangement for hardening drawing dies, which I think is better than the one shown by G. D. at page 1773, Vol. 26. The center of a die can be made harder by the constant forced flow of the cold water through it than by using the tongs as he shows.

Referring to the sketch, *A* is a cast-iron block, roughly bored and fastened over a drain pipe; *B*, the die to be hardened; *C*, a pipe about 1 inch larger in diameter than the hole in the die and about 8 or 10 inches long; *D*, the cold water faucet. By placing the die in the position shown and turning on the water so that it fills the pipe *C* nearly to overflowing, the water will be forced through the die, which when cold will be of the proper temper.

From what G. D. says of draftsmen I



FOR HARDENING HOLES IN DIES.

conclude that if he was manager of a large concern, he would have all the tools and dies designed by the machinists in the shop. While the machinist may be capable, he is not the one to do it, as it takes his time to get the design of what he wants into his head, and then he must work slowly and cautiously or he will not come out right in the end.

When I am working in the toolroom, the foreman who wants a jig made brings me a sample casting, and with a few oral instructions leaves, saying no more. The first thing to do then is to sit down and study out the design of the jig, which takes time. Thinking I have it all in my mind, I start to build it piece by piece, and perhaps when I reach the last one I find I have not made allowances for a certain part, and have the work to go over again, or perhaps throw away and make new.

Now, if I had had a drawing I would not have lost time in studying the design, and could have worked much faster by

having the dimensions before me, and when the job was finished it would not only have been right, but would have had a better appearance, and not half the time used as without the drawing.

I have known instances of a forming die being made by a toolmaker under the instructions of the foreman, and after two weeks' work finding where certain allowances had not been made, thus spoiling the work.

The managers of the large concerns know what they are about when having draftsmen to design tools, dies, etc.

Cleveland, Ohio. E. S. C.

Grindstones and High-Speed Tool Steels.

Editor American Machinist:

At page 1639, Vol. 26, "Iron Quill" draws attention to that much neglected machine, the common shop grindstone. His letter gives the impression that he is running a 30-inch stone at 450 turns per minute, which I think must be a mistake, as this means a peripheral speed of 4,950 feet per minute.

Some time ago I found myself responsible for five grinding troughs (pronounced "trow" in Sheffield) with 6-foot grindstones, all of which are used for grinding heavy planing and slotting tools, etc.; and as no two of these stones were speeded alike, I began to make enquiries as to the best safe speed. The faster a stone runs the better it grinds, so that the limit is only determined by considerations of safety. For manufacturing purposes in the Sheffield trades, grinding edge tools, shear blades, etc., the usual peripheral speed is about 2,000 feet per minute; but as accidents due to bursting stones are not unknown, and in a crowded machine shop such an accident may have far more serious results than in the small grinding "hulls" which contain nothing but grindstones, we prefer to keep well on the low side, and have fixed on 1,600 feet per minute as the standard speed.

Molesworth gives 650, and the "Practical Engineer's Pocket Book" 800 feet, as the right speed for tool grinding; but it is impossible to grind tools, especially of the new high-speed steels, satisfactorily at these low speeds.

Taking 1,600 feet per minute as the right speed, the following is a simple and easily remembered rule: Make the pulley on the driving shaft of such a size that its diameter in inches multiplied by the speed of the shaft in revolutions per minute equals 3,000.

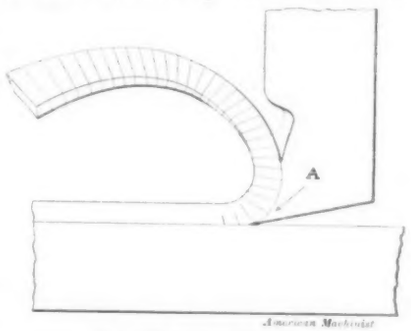
Thus, if the shaft runs 150 revolutions per minute, make the pulley 20 inches diameter; if the shaft runs 200 revolutions per minute, make the pulley 15 inches diameter, and so on.

Then the pulley on the grindstone spindle should be just half the diameter of the stone. Thus for a new 6-foot stone the pulley should be 36 inches diameter; when the stone wears down to 5 feet diameter put on a 30-inch pulley, and so on. When once the right size pulley is on the line shaft the most unintelligent helper can remember the second part of the rule.

One feature of the new high-speed tools is that when ground on an ordinary emery wheel, even under a flood of lubricant, the surface of the steel becomes covered with fine hair cracks.

We use very heavy tools of the new steel, 2½x2 inches for round nose and 3½x7⅞-inch section for parting tools, finding that smaller sections are not strong enough mechanically to carry the heavy stresses due to the increased speeds and feeds. Another advantage of the large section is that the heat generated at the cutting edge is more quickly dissipated.

I have often been shown dark blue steel shavings as a testimony to the wonderful qualities of the new tools. I believe some of the brands do not stand well unless they are run red-hot, but my experience with the "self-hardening" brands, which are much more commonly used over here, shows that though they will run well dry and produce the wonderful blue shavings so much admired by the inexperienced,



PLANER TOOL AND CHIP.

they will produce the same shavings of a normal color and run for a much longer period without regrinding if they are kept cool and well lubricated.

This may be accounted for by the fact that these tools generally give out, not by the failure of the cutting edge, but by being worn away by the friction of the chip where it rubs on the nose of the tool in curling away, as at *A* in the sketch. It is natural to suppose that this abrasion will take place more slowly when the tool is cool and hard than when it is red hot.

We have found that these large tools are much better ground on the grindstone than in any tool-grinding machine on the market, partly because of the hair cracks above referred to, and partly because they are too large to be expeditiously handled even in the largest size Gisholt and Sellers machines.

We have made a special trough to take a 6-foot stone, with a swiveling rest and compound slide; and by means of a few small stops and fixtures held by T-slots in the table we can quickly and conveniently grind tools to the standard angles and radii. MAURICE E. UNWIN.

Sheffield, England.

[We published in 1890, as many of our readers will recall, a number of contributions on the relative merits of emery wheels and grindstones and the surface speeds at which the latter might be safely operated. Prof. John E. Sweet, who opened the discussion, giving the satisfactory experience he had had with an 18-inch stone running at a speed of 3,000 feet per minute, and in a subsequent letter expressing his belief that stones of that size could be run much faster than 3,000 feet with safety. Mr. Chas. A Bauer in a letter at that time gave the limit of safety for Ohio grindstones as being from 2,000 to 2,500 feet, and for Lake Huron stones, from 2,800 to 3,500 feet per minute; his formulas as given for safe surface velocities were as follows, d being the diameter of the stone in inches.

For Ohio stones:

$$\frac{10{,}000}{d+6} = \text{rev. per minute.}$$

For Lake Huron stones:

$$\frac{14{,}000}{d+6} = \text{rev. per minute.}$$

By the latter formula it would appear that the maximum safe speed of the 30-inch stones described by "Iron Quill" would be 310 instead of 450 turns per minute.—Ed.]

Hardening and Correcting the Lead of Taps.

Editor American Machinist:

At page 1771, Vol. 26, Mr. E. R. Markham gives a method of hardening taps, which he says does not change their length by shrinkage. Taking it for granted that this is so, I must say that I do not believe the case-hardening method will produce as good a temper or make as serviceable a cutting surface on a tap as when it is heated and cooled in oil in the ordinary way.

My reason for this unbelief is based on the fact that taps are usually subjected to hard service, and a skin-deep hardening, if it does not yield at once, will do so as soon as this surface is removed by the sharpening or grinding processes. Besides this, I think it next to impossible to give reliable instruction in tempering, in this or any other way, which will apply equally to the varying grades of steel as met with in everyday practice. Indeed it is admitted by tap makers that no fixed formula applicable to shrinkage can be made available, on account of the varying chemical constituents of different steels.

That the element of shrinkage in tempering is one that is recognized in tap making is clear from the fact that lead screws on lathes for this purpose are sometimes stretched to meet this requirement. Yet the extent to which this may occur is not so great as might be inferred from Mr. Markham's statement in the outset of his remarks. He says: "It is not an uncommon thing to find taps in use that have contracted sufficiently to change the lead 1-100 inch in 1 inch of length." This, it will be seen, would amount to a shrinkage of 1-10 inch in 10 inches, which

is doubtless about four times as much as would ever be found in the worst cases.

In conclusion, I would say that I do not conceive the tap manufacturer to be in need of instruction along these lines; but the toolroom man who may occasionally want to make an odd tap, with thread of definite pitch, may look with favor upon any suggestion which will help him to do this. As a matter of course, he will not want to incur too much trouble or expense in preparing a case-hardening arrangement for tempering. I would suggest taking a piece of the steel being used and hardening it in fish oil or linseed oil, to see what the shrinkage amounts to, and then elongating the thread on the tap accordingly. QUIRK.

Thread Milling Cutter Angles.

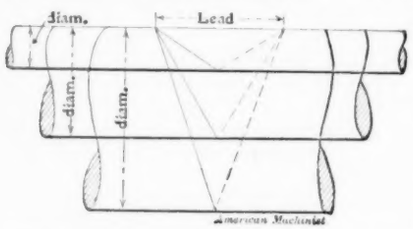
Editor American Machinist:

At page 1801, Vol. 26, Mr. J. E. Stanley in writing about a threading job, winds up by saying "a job of this kind will make most of us appreciate a Pratt & Whitney thread milling machine."

Yes, this is an ideal way of cutting threads—provided you have the cutter for the case in hand; and as far as I can see right here is where the trouble is going to be.

The common practice is to state the number of threads per inch, or give the linear pitch. Now, if this system is used, it means that to be exact (and what is the thread milling machine for if not to assure accuracy?) one must have a different cutter for every different diameter of the same pitch; for we all know that the angle varies with the diameter when the lead is constant. This is graphically shown in the sketch; and if the angle varies, then the width of the cutter varies, as explained in connection with the thread tool at page 875, Vol. 26.

If the thread milling machine is to do away with the lathe for this class of work,



SHOWING CHANGE IN HELIX ANGLE WITH CONSTANT LEAD AND VARYING DIAMETERS.

why not change the method of expressing the pitch and call for normal instead of linear pitch, except of course in the case of lead screws? and as these would be a standard product in the shop cutters of course would be on hand. The Pratt & Whitney Company no doubt have looked into this side of the question, and it would be interesting to hear from them.

Personally, I am very curious to know what is the correct cutter for a V-shape multiple thread. Would the V-angle be changed, or would the depth of the thread be changed and the 60-degree angle be retained? E. J. LEES.

Points on Grinding.

Editor American Machinist:

I read with considerable interest the grinding practice and some questions by Mr. Paul Wesley at page 1837, Vol. 26. The records he shows are very fine ones.

It will be interesting for your readers to note the different surface speeds of his work. The smaller work shows the largest number were produced running quite slowly.

In regard to the best wheel, speed of wheel, speed of work and traverse of table for grinding the ½ inch diameter by 1¼ inch long work, which has been case-hardened, I should think that with the 10x½-inch wheel a 24-36-60 Alundum wheel, grade K, running at 6,000 feet per minute, the work running about 10 to 15 feet per minute, a table traverse of ⅜ of an inch to every turn of the work and the depth of cut all that the belt will reasonably carry—assuming that an effort will be made to give all possible power to the belt on this small wheel. If this is followed and plenty of soda water and oil are used, I should think that, with convenient means for placing the work in the machine and driving it, an operator would be enabled to handle one of these pieces every minute, which would give practically 60 per hour when the operator was continuously at work.

In regard to the method of holding these pieces, a good deal depends upon what conveniences Mr. Wesley may have and how his machine is arranged. It would seem, however, that the greatest amount of time would be consumed in the mounting of the pieces. C. H. NORTON.

Worcester, Mass.

Screw Thread and Other Mechanical Practice in India.

Editor American Machinist:

I also remember being struck with the left-hand screws made by the East Indian jewelers to fasten hinged bracelets (the little spring snap clasp is unknown there). I, however, do not agree with the writer of the article at page 1809, Vol. 26 (from the *Indian Textile Journal*) that "such screws are always a bad fit." I examined quite a number very critically and was surprised to find them an excellent fit.

There are other things which are much more strange to us among the East Indian mechanics. They of course go barefooted and by long practice, and possibly by the influence of heredity, are able to use their feet almost the same as an extra pair of hands. The native wood-turner's lathe is a very crude affair. The bed, made of wood, is placed on the ground without any legs. The operator squats on his hams and uses his left hand to work the bow that actuates the live spindle. It is evidently correct practice to balance the body on both hams and the right foot (that is no doubt where we got our three-legged lathes and three-footed jigs), and operate the turning tool with the right hand and left foot, for they all do it.

The cutler's method of grinding was another thing that interested me immensely. The grinding wheel, made of wood, is about 6 feet in diameter by 3 inches face. This is hung on a wooden shaft about 8 inches in diameter by 4 or 5 feet long, and in the center of each end of the shaft a round iron pin is driven as a journal.

The periphery of the wheel is charged with some abrasive compound; I could not find out what it was. These Orientals guard their trade secrets most jealously, and although I tried to bribe the boss with 4 cents, to give me the formula, he gave me the stony stare instead. One end of a leather strap is fastened to the shaft and coiled several times around it. The helper grasps a cross handle fastened to the other end of the strap, gives a steady pull (much the same motion as rowing) and the strap unwinds and then rewinds round the shaft, the next pull sending the wheel in the opposite direction. The boss cutler sits on his hunkers, the same as the aforementioned lathe hand, holding the piece to be ground in both hands. Between the great toe and the next one of the foot which he is not using as a prop for his body, he holds a piece of unglazed pottery, which he applies to the face of the wheel every now and then, evidently to cut the glaze on the wheel. Of course, as the motion of the wheel reverses, the operator reverses the article being ground.

And so on through every variety of handicraft, from the grinding of flour to the making of the most delicate fillagree silverware, the methods of manufacture are the same to-day that they were a thousand years ago; and yet I have seen work that it would be hard to duplicate for the same money in this country.

For 4 annas (about 8 cents) I bought a nest of little cylindrical wooden boxes made on a hand lathe. The outside box, about 2 inches diameter by 3 inches deep, contained ten other boxes gradually decreasing in size to the smallest. The turning was good and the lid of each box fitted nicely.

Of course wages are very low, and living very cheap, especially so to the natives. Stevedores get 8 annas (16 cents) and 2 rooties a day. A rootie is a small loaf of bread about the size of a man's two fists. From 4 to 6 annas is a fair wage for a laborer.

At Karachi I have bought a dozen live ducks for a rupee (32 cents). Karachi is famous for turtles and oysters. As soon as a ship arrives and is berthed, the oyster *walla* (*walla* is a man) comes on board and makes a bargain for a lump sum, as much as he can get, with each officer an engineer to bring him a dozen or two oysters each morning as long as ship is in port.

We lay there two weeks, and I got my fourteen dozen oysters for 32 cents. The second mate, who had been there before, got his for 16 cents. Occasionally the oyster *walla* gets stuck, for tramp steamers are uncertain in their sailings and sometimes stay a month or two in a port waiting for a charter.

E. A. SUVERKROP.

On Reciprocating Motions.

Editor American Machinist:

At page 1805, Vol. 26, Mr. Tecumseh Swift has an article on "The Obsolescence of the Reciprocating Movement." Now, generally speaking, I thoroughly agree with him, although he makes some remarks that I must take exception to. In our work we have one job that at present is done by a rotary motion, which is a decided exception to the general rule. It is a job of cutting with a formed tool a steel block, ½ inch thick. We use a special fixture to hold the work, and the fixture has to be 3½ inches diameter, as the face of the work must have an approximate radius of 2 inches. We have to run the lathe in the back gears, and as the cut is but ½ inch, there is more lost motion than I ever saw in the slowest reciprocating motion I have met with. As Mr. Swift says he never heard of a case where the change has been from the rotary to the reciprocating, I don't know but he might be interested in hearing of one at least where it will be made in that direction. I have designed a special machine for this job, and as soon as I can I am going to build it. It will be a reciprocating machine of the shaper variety. The reciprocation of the work instead of the tool will be accomplished in a way that will practically instantaneously return it. The cutting motion will be obtained by a spiral cam, and the return motion will be obtained by cutting off nearly one-half of the cam, making it nearly an exact half of an eccentric with the other side flat.

D. W. ROGERS.

An Interesting Threading Job.

Editor American Machinist:

At page 1801, Vol. 26, Mr. Jas. E. Stanley describes, under the above title, an operation which reminds me of a somewhat similar job which I have seen done in the shop where I was employed before I took my present position. The threads were really on worm shafts, and I think the pitch was 1 inch; they (the shafts) were forgings with the worm part forged on them. They had to be made this way, as the bottom of the thread was the same diameter as the shaft. They were cut in three operations, two of which were accomplished with a cutting-off tool in the compound rest; the latter was set at the proper angle and the feed obtained with the compound rest screw; although the cross-feed screw was also used. The stop screw was set when the first cut was taken and the tool was withdrawn from the cut with the cross-feed; then in starting the next cut the cross-feed was returned to the stop, without disturbing same, the successive cuts being obtained with the compound rest screw until the threads were finished on one side. By using the cross-feed screw to back off the tool all the work with the compound rest screw was to advance the tool for each cut. These shafts were made in lots of twelve, and the whole twelve were cut on one side of the thread before the other side was touched; then the compound rest was swung round for the other side of the thread and that side of the twelve finished. Then with a tool that fitted the thread two or three light scraping cuts were taken through each worm, using the cross-feed screw for this third operation. I neglected, by the way, to say that in the first two operations allowance was made for this finishing cut. The space occupied by the thread was laid off before starting in on the cutting, and when the second operation was completed the center of the threads was left in a helix as the cuts from each side met at the bottom. Of course this would be an ideal job for the thread milling machine, but at that time it was not on the market. I would be willing to wager, however, that they will have one of them to handle this and some similar jobs in that shop.

D. W. ROGERS.

Taper Holes in Machine Spindles.

Editor American Machinist:

At page 1785, Vol. 26, appeared an article entitled "Taper Holes in Machine Spindles." Now, I have had a large experience in that class of work with the Brown & Sharpe Manufacturing Company, and in fact for several years have had charge of making all their spindles, turning out thousands every year, and I cannot see how Mr. Kleinhans can get a good, true spindle with a perfect hole with the method he describes. It might do if they do not have to run very true, but ours have to run within 0.0005 inch limit. The way we put the holes in ours is to catch the small or rear end of the spindle in a true chuck instead of clamping it back to the face-plate, which is sure to cramp it; the other end of course is run in a steady rest. We use three reamers: the first is nicked very deeply so the cutting edges look about like saw teeth; the second is very similar to the one described by Mr. Kleinhans. These are held firmly and oil forced through them at 175 pounds pressure, to wash out the chips. The third reamer is formed without nicks and is made to float so as to adjust itself to any position and leave the hole true to taper, which is tested by a standard plug hardened and ground to perfect taper. We next put the test bar (about like the one shown in the article referred to) in the hole, catch the rear end of the spindle in an independent chuck, set our steady rest on the bar as near to the mouth of the spindle as possible, put an indicator at end of the bar and throw the end of the spindle in the chuck until the end of the bar runs true at the indicator; then we turn up a place at the rear end for the steady rest, insert in the taper hole a special plug which is hardened and ground to the correct taper, put a dog on the end of the plug, place this end on the live center, holding it back by two spring dogs to the face-plate, put the steady rest at the trued spot at the other end and true up the back center. We next test the spindle to see if it is true by putting the test bar back in the taper hole and mounting in the lathe with the outer end of the test bar on one center and the rear end of the spindle on the other; with the indicator against the bar as near as possible to the mouth of the hole we turn the spindle by hand (with the lathe still) and if we find it needs correcting we scrape the rear center of the spindle until it is true. The spindle is then machined, but before grinding we test it again in the same way.

ELMER F. TANNER.

Providence, R. I.

Proportions of Pulley, Gear and Lever Hubs.

Editor American Machinist:

The notes below are from actual practice, and give averages taken from the practice of four large manufactories of gears and pulleys regarding the diameters of hubs and bosses in proportion to the diameter of the shaft represented by D

CAST IRON.

Heavy, very great shock.....	2 D
Standard, medium shock....	1¾ D + ⅛"
Light, no shock.....	1⅝ D + ⅛"

CAST STEEL.

Heavy, very great shock.....	1¾ D + ⅛"
Standard, medium shock...	1⅝ D + 3/16"
Light, no shock.....	1½ D + ¼"

Following are the lengths of hubs and bearings in proportion to the diameter of the shaft:

Hand wheels.....	1½ D to 2 D
Truck wheels.....	2 D to 2¼ D
Levers.....	1½ D
(In no case less than D.)	
Gear wheels.....	1¾ D to 2¼ D
Bearings.....	3 D to 4 D
Pulleys.....	⅔ face.

In the first four cases of the second table the length of hub in cases in which it is movable on its shaft is to be treated as in the case of bearings.

HERMAN JONSON.

Non-Freezing Shop Windows.

Editor American Machinist:

At page 1791, Vol. 26, you publish a recipe for preventing the freezing of windows. This winter I have noticed in store windows a method that works very well, and that is to place a small electric fan in the window two or three feet away, and let it run blowing the air at the window.

I suppose the explanation is that the

moisture is all dried off, hence leaving nothing to freeze; anyway, the glass is perfectly dry and clear. At the same time I think it is a very good advertisement, as the casual passer-by generally stops and tries to figure out why the fan is running. Perhaps the real reason never dawns on him until he realizes by contrast the difference in the appearance of the window glass in that store. E. J. LEES.

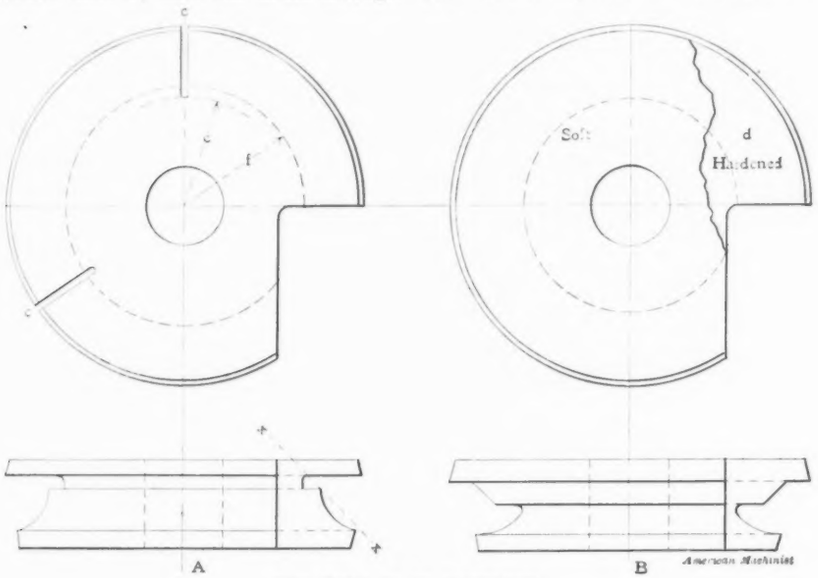
Warren, Pa.

Two Cutter Hardening Kinks.

Editor American Machinist:

I send you a sketch showing two styles of circular cutters which, owing to their shape, gave much trouble in hardening. I am aware that cutters could be designed to lessen such trouble and insure hardening without cracking, but in this case I was held to certain sizes given in a sketch.

Cutter *A*, owing to its form, gives more trouble than *B*, and will crack through



THE TOOLS TO BE HARDENED.

X X almost every time. The cracking is caused by uneven contraction in the metal, the thin flange cooling very quickly and the heavy body slowly. I experimented with different methods of hardening, but without good results, until I hit upon the two schemes indicated at *c* and *d*, both being so successful that the hardening gave me no further trouble.

With a hack-saw or milling cutter about 1-16 inch thick I cut into cutter *A* in two places, making the divisions about as shown in the sketch. It is very important in making the saw cut that the bottom of the cut be about ⅛ inch deeper than the smallest diameter of the cutter; or, in other words, radius *e* must be ⅛ inch less than radius *f*. In the case of cutter *B* I did not make the saw cuts, but simply cut away enough stock to secure a cutting face in the regular way, then hardened a part of the cutter about as shown by the broken line, leaving the rest of the cutter soft.

Not long ago a young machinist told me of his troubles with cutters of this kind, and I suggested his trying this method to overcome the trouble. Instead of looking into the idea he seemed much insulted at my nerve in asking a mechanic to make a cutter in this way. G. D.

Photography as a Time Saver.

Editor American Machinist:

Photography is usually never employed by the draftsman at all, and the average employer never thinks of using it except when he has built a special machine which he would like photographed. Then he calls in a professional, and backgrounds are put up, and other elaborate preparations made.

Photography, from being a skilled profession, has become of late years little more than a simple mechanical process. With good apparatus and a regard for the rules, bad work is impossible. Therefore there is no need to bring a professional in to do it unless there is either enough to keep one employed all the time, or so little that the apparatus would never pay for itself.

Existing drawings or sketches can be copied, and if there is much detail in them photography is cheaper than tracing, and any variation from the original is impossible. Existing machinery, or details of machinery, can be photographed, and if preferred a tracing can be made from the photograph, or the photograph itself can be turned into an accurate pen and ink sketch by inking in the outlines, and then bleaching out the photograph itself. This can easily be done by several different methods.

The practice of enlarging which is coming more into use greatly reduces the expense of materials and apparatus. It is not now necessary to use large plates, or have a large camera, or a large and expensive lens. A lens that would perform faultlessly on a plate measuring, say, 5 inches by 4, but be very bad on a plate of twice that size, would nevertheless accurately transfer an enlarged view from the 5x4 negative to a sheet of paper of far greater size. The only essential things therefore are a small stand camera and a darkroom. The room must be rigged up for doing the enlarging in; and the camera may with advantage be larger than the size plate it is intended to ordinarly use in it, and have its slide fitted with adapters for smaller plates.

A perspective tracing or line sketch of a machine can be quickly and accurately obtained without using a plate at all. It can be photographed direct on to a piece of bromide paper, limited of course to the size of the camera. This gives a negative which is as good for inking in or tracing from as a positive. A disadvantage about it is that everything appears on the opposite hand, the proper way to look at a tracing from a negative being to turn the tracing paper over. The best plan of course, though it takes more time and necessitates two operations, is to make a small glass negative first and then enlarge from it to the required size on paper.

Dead front views, plans, end views, etc., to scale just as they would be drawn of course cannot be obtained with the camera, except from already existing drawings. All photographic lenses, no matter what their focal length, give the amount of perspective that we actually see. Draftsmen have accustomed us to about half that amount on paper. In mechanical drawing, perspective has to be ignored. A front elevation of a long lathe, for instance, would consist of parallel lines on the working drawing without a sign of end view on any part. A photograph of the same, taken dead in front, would show the inner faces of both headstock and tailstock. Then, again, in photographing actual objects with the camera, only those parts which are in the same plane are to the same scale. The amount simultaneously visible on the inner faces of headstock and tailstock shows the extent to which all parts taper away according to their relative distance, the back edges appearing closer together than the front. Therefore on actual objects the camera can only be used for perspective views. Copying drawings and intricate sketches is another matter. Here the camera, if properly adjusted, will reproduce precisely what is on the paper before it, with the advantage also that the scale of the original can be altered if desired. For copying drawings in black and white an extremely slow plate should be used.

Here is another purpose for which I personally have found photography extremely useful, and I give the hint to other contributors who want to turn out good illustrations for anything they wish to contribute. They don't need to be either good draftsmen or good photographers in order to do it. A perfect perspective view of anything may be obtained by photograph-

ing it, printing to the required size on bromide paper, and then making a tracing to send for reproduction. In many cases tracings can be built up from a number of separate prints, and parts which are not worth photographing can be put in by hand. For instance, there may be one part full of complicated detail, and another part may have some troublesome curves or perspective, while between or beyond those parts there are only plain lines. Editors like drawings about twice the size they reproduce at, and as large sheets of bromide paper are expensive and the idea is merely something to make a tracing from, small pieces can often be used pasted in their relative positions on a large sheet and after the necessary lines are added the tracing can be made. W. H.

A Box Tool.

Editor American Machinist:

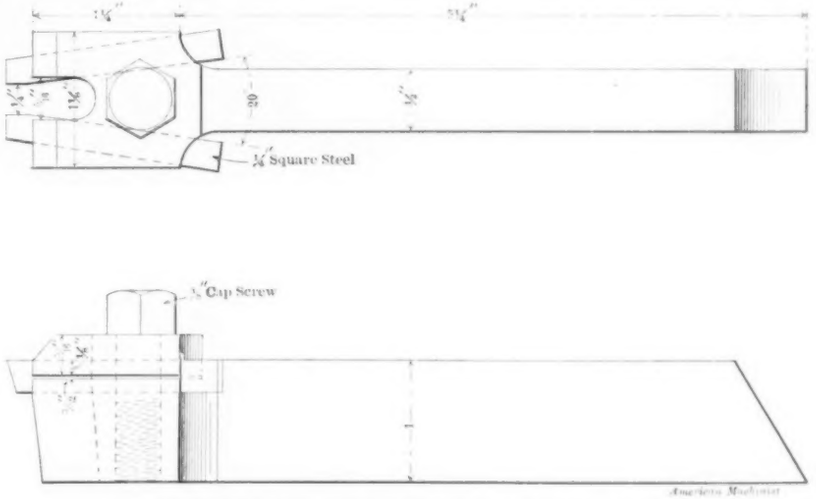
The sketch shows a very simple and efficient box tool, made from a piece of 2½-inch machine steel with a shank turned down to fit the turret, and a hole *A* bored out to take stock up to ¾ inch in diameter, or even larger if desired.

The cutter *B*, a piece of ¼-inch square, air-hardening steel, is held in a slot, milled in the body by a ¼"—20 set-screw *C* through the clamp *D*, which is itself secured in place by two fillister-head cap-screws *E*. Opposite the cutter a slot, ¾ inch wide by 5-16 inch deep, is milled to receive the V-block *F*, or steady rest, which is slotted as shown and held in place by the hexagon-head cap-screw *G*.

This tool is exceedingly easy to make, and answers many of the requirements of much more expensive tools. The back rest *F* would doubtless be more efficient if placed at an angle of 45 degrees to the line of the cutter, as shown in Fig. 2; this, however, would make the tool a little more difficult to construct, though I am confident the additional efficiency secured would more than pay for the extra labor involved in making the tool.

You will notice the cutter is slightly in advance of the rest, the slot for the latter being 1-16 inch deeper than the cutter slot. The object of this is, of course, to allow the cutter to turn a cylinder to run in the "V." C. H. RAMSEY.

[This tool, we should imagine, would be better suited for certain classes of screw machine work, if the back rest were made in two parts, with each half independently adjustable to the work. This plan permits it to be centered without trouble.—Ed.]



ADJUSTABLE TOOL USED IN PLACE OF CIRCULAR CUTTER.

An Adjustable Tool Used in Place of a Circular Cutter.

Editor American Machinist:

The sketch shows an adjustable tool made to take the place of a circular forming tool. We had a lot of wheels to be faced to .255 inch in width and we used the old style circular tool; when the wheels were finished we discovered we wanted them .250 inch in width, so I made this adjustable tool and we can now face the work to any width desired without the expense of making new circular tools. The tool is adjusted by loosening the cap-screw and pushing the two ¼-inch square cutters forward or back, according to the size desired. The two cutters are of self-hardening steel, and as these can be renewed with very little expense the tool will be found an economical affair for anyone who has work to form to certain thickness. ALBERT ELMIGER.

Reciprocating and Rotary Motion.

Editor American Machinist:

I red Meester Tecoomseh Swift's piece at page 1805, Vol. 26, und I vish to say dat dere vos too sides to dot story. Vos not de sveenging of de sledge in receviting rotary moshun? Is not de moshun of air receviters reciprocal und don't dat constitoot progress? I dink dot putty near oil dis talk apout rodary moshun peing petter is nonsens. Let Mr. Swift's eat de next biece of pie mit a rodary moshun, und I pet he take pack oil he sed.

HANS.

Taps With Soft Heads—Standard Taper Pins.

Editor American Machinist:

My attention has been very strongly directed to a thing we have all seen many times. I refer to headless taps and reamers, meaning those with the squares twisted off or so much out of shape that they must be cut off before making other heads. This condition is most noticeable in small and medium sizes, and is not confined to any one make of taps, as they all seem to act about alike in this respect, *and no one finds any fault,* although a few taps broken or twisted in the thread would be enough to condemn the whole line of a manufacturer. It seems to me that a perfect tap

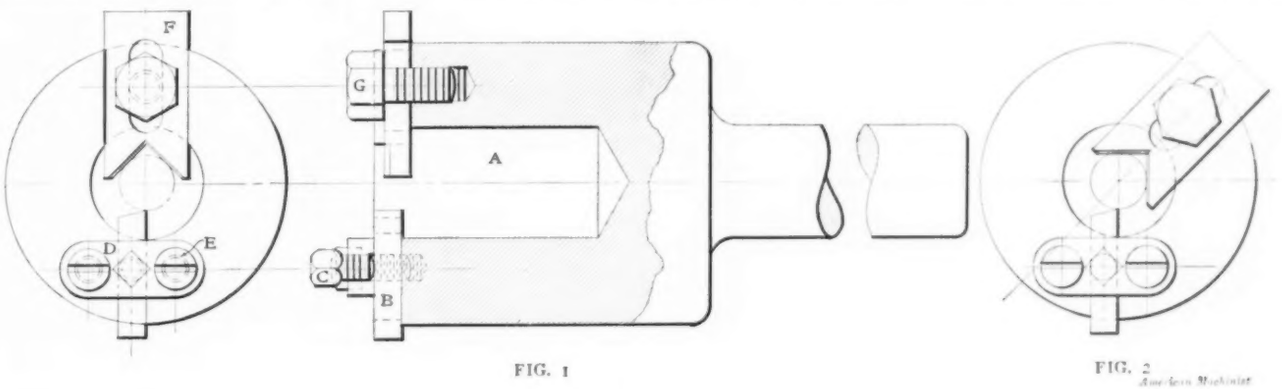


FIG. 1 FIG. 2

A BOX TOOL.

or reamer should have its shank and square so tempered as to retain its shape as perfectly as the cutting portion, and I do not see this to be difficult in accomplishment. For payment of the increased cost of manufacture one of the extra 5-per-cent. discounts might be withheld.

. . . . . .

The use of taper pins, it would seem, might be improved very materially by simply changing the standard of measurement from the *head* to the *point*. At present all lengths of the same number are made from the same diameter of stock, with but little loss of material in shaving. This is all right for the makers, but with the users the case is different. They must use a different size drill for each length of pin of the same nominal size, if they would save in reaming, and this fact has caused mistakes several times in my experience.

When reaming in pins it is customary to use the shortest pin long enough to come through flush when in place. After the machinery has come to repairs and the pins are loose and the holes are worn, there is no such thing as taking a regular stock-pin, ¼ inch longer, cutting off the point and putting that in after truing the holes with the reamer. Instead of that you must either make a special pin for the place or take the next size larger, and then there is a lot of reaming. The Cleveland Cap Screw Company have made the improvement in cap screws. Who will do it in taps, reamers and taper pins?

CHARLES S. BEACH.

Bennington, Vt.

Accuracy in Core Box Making.

Editor American Machinist:

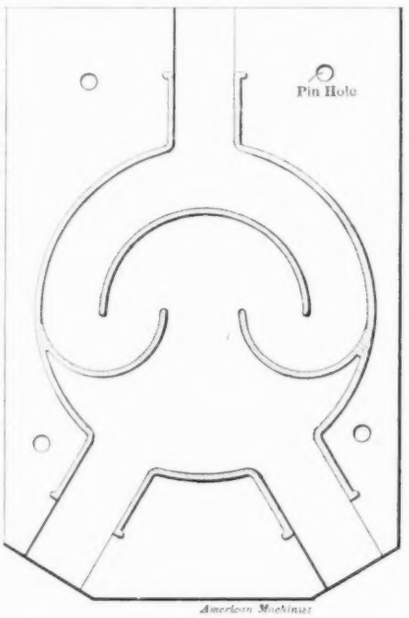
In all kinds of pattern work the core box plays a most important part, often involving much more labor and closer attention than the pattern itself. The reason for this is obvious. By means of it the core is formed for hollowing out, so to speak, the inside of a casting. It is essential, therefore, that the workmanship be as nearly perfect as possible. Particularly true is this in all jobs where thin metal is required. In most small brass castings, and in some of iron as well, the metal is required to be but ⅛ or 3-16 inch in thickness, and any inacurracy in the core is apt to result in a bad casting, or, what is equally faulty, in rendering the metal uneven in thickness.

The accompanying sketch from an actual job will serve well to illustrate my meaning. It represents half of a core box for what is called a mixer, made of brass. The diameter of the outer shell is 8 inches, while the metal is nowhere thicker than a full ⅛ inch. Now, to ensure this uniform thickness nothing short of perfect work will answer. Care must be taken that the *holes* in the box tally perfectly in size with the *prints* on the pattern and that the box itself is exactly the same in length with the pattern. The core when made must fit exactly into the impression in the sand, otherwise the metal failing to flow uniformly in all directions, will produce an imperfect casting. The conclusion of the whole matter is that in all cases where thin metal is required, only accurate workmanship will produce satisfactory results. HOMO.

Card and Other Systems.

Editor American Machinist:

Many people look on a card cost-keeping system as an expensive luxury, to be used only by firms which have "money to burn," and of no use to a firm which is out for *business*, and not for show. I believe someone made a remark not long ago asking which is the better—"to gain two dollars and not know exactly where they came from, or lose two dolars and know exactly where they went," which seems to hint that a card system is a losing game. It is not, although I personally know many superintendents who look upon a modern system as a general nuisance and a whole lot of red tape, but that is because they have not studied the various systems enough to appreciate their true value. Modern competition is becoming such that a manufacturing concern does not make such a great profit out of its goods that it can afford to run in the dark and not know exactly where and what the expenses are, or where the profit comes from.



A CORE BOX REQUIRING ACCURATE PATTERN WORK.

Imagine a firm manufacturing a variety of products. At the end of the year they have a certain profit, but do not know where it came from. Anyhow it is profit. Good; but some of its departments may have been running at a loss, unknown to the firm, which, had a system of cost-keeping been in use, would have shown up at once, and the reason why, and steps would at once have been taken to "brace up" those departments, so that instead of absorbing part of the profits of other departments, they would be adding on their own account, and the results would be perhaps to double, or triple, the profits at the end of the year, all through that firm indulging in the expensive luxury of a card system.

Suppose "a good old idea" firm to be suddenly called upon to fill a large order by contract. The president calls the superintendent and asks him to quote the cost. The superintendent has no records, and so goes around the departments and asks the various foremen, who probably know less than he does, but they do a little figuring and a lot of guessing, and in time all turn in their results. The superintendent has a handful of papers, covered with guess figures; he collects them all together, does some guessing on his own account, and hands the results to the president, which may be low enough to nearly or totally bankrupt the firm, or high enough to make the profits of that year stupendous, *if* they *get* the contract. The president, superintendent and foremen are all in blissful ignorance of what the figures mean, and the actual results depend upon how near to the actual figures they managed to guess, and some men are mighty poor guessers.

Next there is the superintendent of the modern factory, who knows exactly how much profit each department and subordinate department is making, and if one department fails to run at a profit, there is a sudden inquiry—no waiting till the end of the year to find what profit is being made, with, if low, the usual "jacking up" of the whole force, in hopes of hitting the right party. No, this inquiry comes along at once. The foreman is asked: "Why were your results so poor for yesterday?" Probably it was because of poor raw material; maybe some of the green help spoiled a lot of the product, but *perhaps the foreman was not attending to business.* The superintendent knows why and has the cause stopped on the spot. There are no leaks in the profits which run for years and are found by accident, if at all. There are no men around who just come to make up time, and only take an interest in the firm on pay day. No; each man at that place earns his pay and a little more; but it is not a nigger-driving nor cut-rate establishment. Its employees get more pay, and are better treated than at the "old time place"; everything runs like a clock; every man knows exactly what he has to do and how much is the minimum amount to keep his position, and how much extra he will be paid for exceeding that amount. There is no room for arguments and disputes as to who should do this or that. The words, "I forgot," "You never told me," and "I did not understand it in that way," are not heard, for all orders are in writing, plain and definite, and there is room for only one excuse—*incapable of filling orders;* but such

men do not work there, or, at any rate, not for long.

If the company decide to contract for a big order, the president tells the superintendent, who does not consult the foremen nor the men, although he may have a talk with them about it, but he gets his data from previous cost cards, and figures exactly, including unproductive labor, power, maintenance, fixed charges, etc.—all from actual figures, with no guess work. He gives the president the estimate of how much it will cost the factory to fill that order, and the president adds the percentage of profit and sends in the contract, having very definite ideas how much profit he will make on the order if he gets it. If he does, and the order is filled, on the day the last shipment is made, the superintendent gives him the exact, actual cost, to compare with the quotation, and the difference is found to be very slight, and nearly always to the credit of the factory. Now where does the expensive luxury come in? A well-designed cost-keeping system leads to but little extra expense, the information is of enormous value, and hundreds of firms fail through not having it. Of course one occasionally meets with a cost-keeping system carried to an extreme, but we can find extremes in most things. Do not blame a system because of a few extremes.

A good system of cost-keeping is an absolute necessity now, and is a very expensive luxury to be without, and is becoming more so every day.

KNOWLEDGE IS POWER.

Systematic Filing and Recording of Data.

Editor American Machinist:

In manufacturing machinery of any kind a large number of data are being continually collected and, though the expense of making this collection is often large, the results of the work are not as fruitful as they should be, owing to the inaccessibility of the acquired information. It is not an uncommon thing to have the same piece weighed over and over again, or the same calculation repeated because it is easier to do it than to search through records to find the first result.

In many moderate sized shops where elaborate records cannot be afforded and where a considerable part of the product is special machinery made by combining some standard parts with other special parts, it is often difficult to secure reliable data on which to base the cost of a proposed new machine. Of course the weight of each piece can be calculated and its cost estimated, but many of the parts may have been made before, and their rough and finished weights determined and carefully recorded where nobody would be able to find them.

The cost of each individual piece is not as likely to exist as its weight, but where such information is available it is of the greatest service in preparing estimates. There are a few fundamental principles on which it is logical to base any system for filing data with a view to reducing the labor of searching:

1. Determine each detail *once*, and let the man who does the work be competent and careful.

2. Have a definite accessible place for each result, and keep it where it belongs.

Many people may agree that the principles might be ever so good, but that with a number of persons using and making records it would be difficult to find a suitable place to record such an amount of detailed information without its becoming greatly confused.

The most difficult part of any work of filing is in determining an exact and simple method of identifying and describing parts. For instance, suppose we wish to distinguish between the same part in two machines of the same size and type but a slightly different model, and have some particular information which we wish to file about each piece. It would probably be a very difficult thing to make a description in few words which would so describe the part that anyone else might look for it under that same name or description. There is, however, one way of describing a piece which can usually be made perfectly definite, and that is by giving the number of the drawing on which it is shown. Most people will admit that if our information regarding any part could be put on the drawing of the part it would be likely not to be lost and would be comparatively easily found by everyone needing it. Our part lists and drawing lists would help us find the drawing number, and after that there would be but little trouble. There may be, and doubtless are, cases where it is possible to store a considerable quantity of information on drawings, but the practice is not to be recommended, as the drawing is primarily intended for the workman in the shop and will usually be confusing enough if it has on it all he needs.

As the drawing seems to be the natural and easy place to find information, but the wrong place to put it, would it not be a very logical thing to have a card or sheet for *each* drawing on which to record such things as do not need to be furnished to the workman? This card would bear the same number as the drawing and could be filed to suit circumstances, or if the information was too much for one card, it might be subdivided and put on two or more cards which could be filed in different files for more convenient reference. The cards could be ruled with horizontal lines and each piece on a drawing might be given one line, then vertically ruled columns with proper headings would facilitate compact tabulation. A few things which it might be convenient to record are given below as suggestions:

(1) Rough weight of one piece.

(2) Finished weight of one piece.

(3) Size, quantity and kind of stock required.

(4) Manufacturer's name, catalog number of any articles called for which are to be purchased.

(5) The cost of manufacturing or purchasing certain articles.

(6) Number of pieces for one assembled unit.

(7) Departments of the shop in which work will be performed on each part.

LISTED BY *E.A.J.*
CHECKED BY *H.S.B.*
WEIGHTS BY *W.A.G*
DATE *July 5 1902*
LIST AND WEIGHT OF PARTS SHOWN ON DRAFT *3362*
SUBJECT *Intermediate Shaft & Gears*

CLASSIFIED WEIGHTS OF UNFINISHED PARTS											WEIGHT EACH	NUMBER PIECES	PATTERN	NAME	SIZE
		CAST ROLLED STEEL	CHANNELS	ANGLES	PLATES	BAR	MAL. IRON	CAST BRASS	CAST STEEL	CAST IRON	SPECIAL CLASS				
								25.				25.	1	G 362	Gear
									.49			20.	2	G 363	Pinion
						96.						96.	1		Shaft
		.7										.7	4		Key
		.8										.8	2		Key
												45.	1		Crank
													6		Cap Screws Hex -

American Machinist

INFORMATION SHEET.

Under article (3) the purchasing agent would find such information as would assist him in procuring sizes and qualities which have been found suitable before. In sheet-metal work this is particularly useful as punching and cutting data are rather hard to find except by consulting notes usually kept by foremen of departments. Under article (6) would be found inform-

ation of great value in preparing shop orders or part lists. In many shops it is the custom to note on drawings the number of each piece shown required for one complete machine. If any particular drawing is used in making more than one machine, these notes are usually correct for the first machine for which the drawing was made, and wrong for most other cases. This may occasion considerable trouble and can be avoided by omitting all such information on the drawing and recording it on the card. In case the same drawing is used in different machines where possibly all of the parts shown will not be required, or will be used in different numbers, the difficulty can be easily solved by having a separate vertical column for each machine and recording in that column the parts for that machine only.

In some shops this method of recording for different machines is followed, but the part lists for each drawing are on the drawing itself. In making out these cards, the draftsman who made the drawing should check the numbers of parts required, as by a little care in this way omissions may be almost entirely prevented and future part lists simply copied from the card.

Under article (7) will be found information of use in making out part lists or piece cards for the shop. The departments through which it is necessary for a part to pass may be indicated by someone entirely familiar with the work, and after that a clerk of ordinary ability can arrange lists correctly for the various department

The accompanying card embodies some of the ideas advanced and has been successfully used in the work for which it was specifically designed. It will be noted that the portion of the card on the left of the weight column is divided into vertical columns, each bearing the head of some material. This system was used in figuring costs and was really a great time saver, as the totals of each card gave the quantities of the various materials for that particular drawing and it was only necessary to multiply and add the totals of cards to quickly determine the material for any particular machine. The method of noting the departments through which each piece should pass will be seen on the right-hand side of the card.

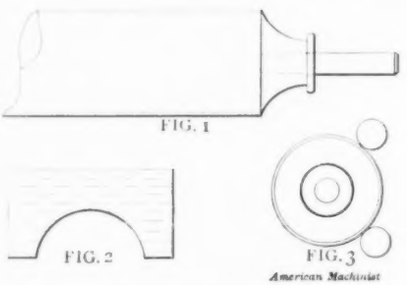
There are of course many manufacturers who make nothing but standard machines and large numbers of each size and type and who can afford more elaborate records than those advocated above, but the principle of having each record made by a competent person and only made *once*, then placed where it will be accessible might often apply to the most costly and elaborate system. K. H. R.

A Roll Grinding Job.

Editor American Machinist:

Fig. 1 represents one end of a roll made of 8-inch steel boiler tube No. 10 gage. The heads are of cast iron, with steel journals 1 7-16 inches diameter, pressed in; the cast-iron head is turned, pressed into the tube and pinned. Up to this point the making of this roll is a plain, simple job; the finishing, however, is quite another matter. It is necessary that the surface of the tube be made true and smooth, and therefore the first thing to do is to straighten it. To do this it is placed in a special machine on centers. This machine is supplied with an hydraulic press mounted on a truck which can be run from end to end of the machine. Blocks, Fig. 2, made of steel castings and bored to the diameter of the tube, are used, placing one or two of them under the tube, as may be required, and one on top under the ram of the press. The straightening is done by pressing, by which operation the bends are removed, the tube is rounded up, the humps are pressed down, and many of the hollows are raised.

It takes but few words to tell what tools are necessary and how they are used, but to do the work and to do it right requires considerable skill, and much practice is necessary to become an expert. The thickness of the stock in the tube will not admit of the surface being turned without making the roll too weak; therefore it is necessary to straighten it as nearly perfect as possible, so that the surface may be ground smooth and true. This grinding is not a simple job such as that of grinding a solid piece which has sufficient stability to admit of the emery wheel being pressed to the work and the surface rapidly removed.



A ROLL GRINDING JOB.

The roll shown is 160 inches long. It could be ground in any grinding machine of sufficient length, but the time required, and the possibility of doing the work in a much less expensive machine and in less time, led us to design a grinder for the purpose. We found by experiments with our regular grinder that it would be necessary to support the roll in some way in order to prevent its springing away from the wheel and chattering. We found that when the emery wheel was forced against the roll hard enough to make a fairly heavy cut, using one wheel, on one side only, the roll would spring away and would tremble so much when at or near the middle, that the wheel would touch at intervals only, making a very rough, chatter-marked surface. This we overcame by a pair of follow rolls, as shown by Fig. 3. These rolls are about 4 inches long, and are at one side of the emery wheel, or, rather, the advance ends of the rolls are in line with the side of the wheel and follow the cut. We found this arrangement prevented the roll from springing away from the wheel, and also stopped the chatter, enabling us to get a smooth surface in a reasonable time. We found it impossible to force the work beyond a certain point, as the roll became heated at the point of contact with the emery wheel, making a very poor surface.

Even with a flood of water the heat would be so great that the surface would turn blue. With the emery wheel, which is 14 inches diameter and 2 inches face, running at 2,000, and the roll at 8 revolutions, and a feed of ½ inch per revolution of the roll, it takes five hours to finish one of these rolls and have it sufficiently smooth and true for the purpose for which it is to be used. I doubt if it be possible to find by experiment a wheel, speed or feed that could do better or more rapid work. With one emery wheel we have ground 120 of these rolls, doing the best and most rapid work when the wheel was worn down to 12 inches. We continued to use it until it was worn to 7 inches.

In starting the cut at the end of the roll, the follow rolls are not in contact at all, care being taken to grind in one spot until a true surface is obtained, in order that the follow rolls may be able to follow on a comparatively true surface and return to the starting point on the same surface. Before starting on another cut, care is again taken to true up the end. The feed used, also the size of the wheel, do not seem to correspond with the usual practice. This job of grinding does not require to be as nearly perfect as does a lathe spindle or work of that class. We do not find it necessary to true up the wheel at all, as it keeps a sharp and approximately true surface without our doing so. B. W. T.

Many Minor Lathe Suggestions.

Editor American Machinist:

In the design and construction of lathes I have often wondered why manufacturers do not pay more attention to various little details, some of which may appear insignificant, although they are very important in the operation of the lathe. I refer to a few items.

Backing belts on lathes have for years been a back number in the modern shop. Usually where two belts are now used overhead, one is for a slow and the other for a fast speed.

The carriages of vario s lathes, as to their travel, are geared differently. When the lathe carriage is geared so that one revolution of the hand-wheel gives a 1-inch movement of the carriage, it is found a great help in cutting threads, as the operator always knows the number of inches or half-inches he has brought the carriage back to pick up the thread, without the use of a scale or watching a chalk

mark on the gears, the latter method being very difficult to become accustomed to.

Where the tail spindle screw is ⅛-inch pitch, it is quite a convenience when drilling, as each revolution of the hand-wheel means a depth of ⅛ inch, a quarter revolution 1-32 inch, and so on. A hand-wheel on the tail spindle screw and also on the carriage is preferable to any other handle. These wheels should be made to balance with the handles in them.

Recently I fitted the slide-rest screws of two modern, up-to-date lathes with graduated dials. These screws were 1-6 inch pitch, which for thousandths calls for 166⅔ graduations. The dials were graduated 165. Of course this was not correct. With a ⅕-inch pitch screw there would have been no trouble.

When the slide-rest screw is made as long as possible and the nut is so located in the slide as to allow the tool, when

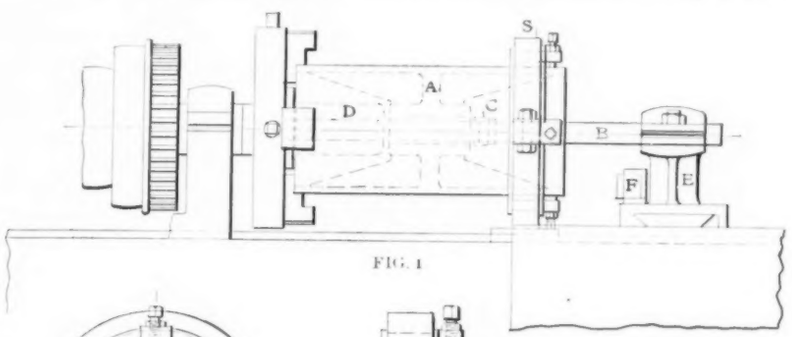


FIG. 1

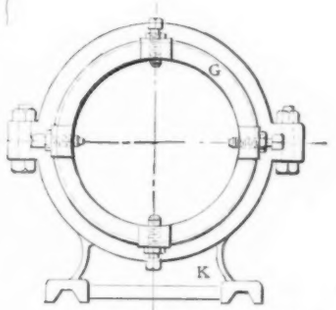


FIG. 2

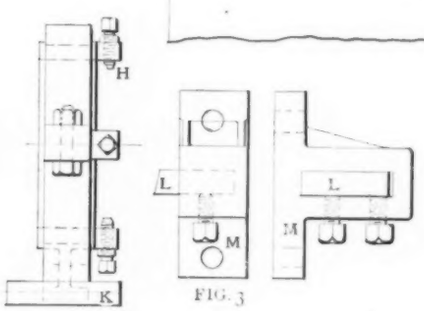


FIG. 3

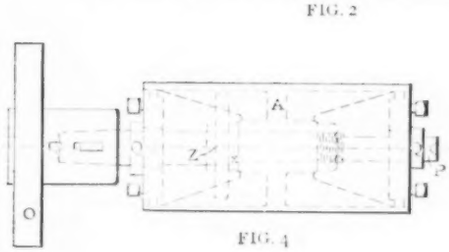


FIG. 4

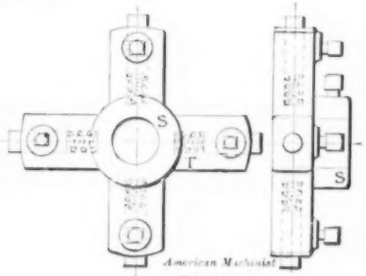


FIG. 5

MACHINING LONG PLUNGERS.

different makes this distance varies from 15-16 inch to 1⅜ inches. Usually when the distance equals about 15-16 inch the tool-post washer and bolster are of such a size that to remedy this defect by reducing their hight or thickness would only weaken them and make them entirely out of proportion. When the tool sets so high above the center on lathes of this description and it is found necessary to turn to the center, the tool must be tilted to an angle of about 12 degrees. The point of the set-screw resting on a tool in this position has a very poor bearing.

A stop for the carriage is one of the necessary equipments of a lathe rarely furnished with the machine. M. L. A.

Boring and Turning Long Plungers.

Editor American Machinist:

Boring, facing and turning long plungers with the hub in the middle, as shown held in the tool-post in a position parallel with the lathe bed, to be fed beyond the center, so that the tool may be made to cut as it were upside down, it becomes an important factor in chuck work when cutting grooves, etc., in the face of the work. When the tool is held in this position it springs away from and not into the work.

The distance from the top of the bolster of the tool-post to the lathe center on 16-inch lathes should be 1¼ inches, this being the usual size of stock used for tools in lathes of this size. In lathes of at *A*, Fig. 1, using ordinary tools, require lots of time and patience. The sketches show an improved way of machining such plungers in large quantities; no springy tools, no chattering.

E, Fig. 1, is a strong boring bar holder put in place of the ordinary compound rest. *S* is a steady rest, shown in detail at Fig. 2, *G* being a ring with four lugs turning in bearing *K*. Each lug is tapped for a steel screw *H* and has a jam nut. The roughing facing tools in bar *B* are made of self-hardening steel, the cutting edges grooved, and while using them the machine is run at low speed until the crust of the casting is removed. These facing tools cover the whole face of the hub. *D* is a boring-bar guide fitted and bolted on the face-plate of the machine. It may be provided with several removable bushings for different bars. *E* is a tool-holder for facing the end of the plunger shown in detail in Fig. 3. In the first operation the plunger is bored and reamed, and the hub and one end of the plunger are faced. To face the other end of the hub the plunger is held against the face-plate of the machine by three long bolts, using the same tools as before.

The outside turning is done with the arrangement shown at Fig. 4. *P* is a mandrel whose taper end fits in a driving piece *O*, which fits and is bolted on the face-plate. *Q Q* are two spiders whose details are shown at Fig. 5. *S*, the body, bored to fit the mandrel, is drilled to receive four pins *R* that are forced outward by strong springs, as shown. Four screws at the sides keep these pins at any position required. *Z* is a strong dog or driver keyed on the mandrel and engaging with ribs in the plunger which is held against a collar *x* by a large nut as shown. The plunger when thus mounted can be heated like a long solid cylinder. No springing or chattering will occur and two cuts, roughing and finishing, will be sufficient.

J. M. M.

Screw Over 85 Feet Long

English engineering skill has again broken the record. Messrs. Somers, of Halesowen, have just formed from a single ingot of steel a screw which (being 11½ inches in diameter) has the tremendous length of 85 feet 7 inches. It has a 2-inch thread from end to end, and weighs 17½ tons. It is to be used for a 150-ton "sheer leg," which lifts heavier weights than cranes can manage.—*London Evening News.*

Patterson, Gottfried & Hunter, Ltd., of this city, have recently installed at their machinery house on Centre street a running exhibit of machine tools and transmission apparatus. So far as we know, this is the first exhibit of the kind made by any machinery house in New York, though for years the dealers of London, Berlin and other European cities have had similar exhibits at their showrooms. It would seem as if local machine dealers had been unduly backward in adopting this method of exhibiting for the benefit of possible customers the appearance and operation of certain tools, countershafts, etc., in motion.

Our readers will share our regret that an accident to Mr. Chas. T. Porter has interfered for the present with the preparation of his reminiscent articles. It is hoped that he will soon be able to resume and complete them.

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Index for 1903.

The index for the AMERICAN MACHINIST for 1903 will be too large to send with the paper. It will be sent free to any reader who requests it, giving full address. Apply to either New York or London office.

The Vitality of a "Good," Though False Story.

Our readers are generally familiar with the widely accepted story that Dr. Lardner, the scientific autocrat of his day and nation, declared in 1835 that a voyage by steamship to the American continent from Europe was perfectly chimerical, and that people might as well talk of making a voyage to the moon. Col. Robert H. Vetch, of the Royal Engineers, has recently written to the *Scientific American*, of this city, showing the falsity of the popular impression, in this matter. The statement attributed to Dr. Lardner as uttered in 1835 was contradicted by him in a speech in 1836, and what he did say was reiterated and explained in his publications. He said that steamships for long voyages could not be *commercially* and permanently successful if dependent upon their traffic alone, in which he was very nearly correct, as it is claimed that the *commercial* inferiority of steamships to sailing clippers continued until the advent of the compound and the multiple expansion engine. The misunderstanding and misrepresentation of Dr. Lardner has not been confined to the uninformed masses, but has been helped along by many learned and eminent men up to very recent dates. The matter came up in 1896 at a meeting of the Royal Colonial Institute, where the story was repeated by Sir Sanford Fleming and contradicted on the spot by a son (since dead) of Dr. Lardner. Lord Hopetoun, before the Institution of Naval Architects, repeated the usual story in 1897, and he was immediately corrected by a writer in *The Engineer*. It can scarcely be expected that so "good" a story will not continue to show signs of vitality perhaps all through the present century, although its falsity seems to be abundantly and authoritatively proved.

The National Association of Manufacturers and the Metric System.

The National Association of Manufacturers is, it seems, taking a vote or expression of opinion of manufacturers as to the desirability of adopting the metric system or of passing a law requiring its use by the different departments of the government—a law similar to the one which was proposed a year ago. The officers of the Manufacturers' Association, having made up their minds that the passage of the proposed law would be a calamity, without, so far as we know, having made any adequate effort to examine the matter from both sides and see whether it would be or not, have so worded their circular as to induce manufacturers (who likewise have made no effort to examine into the matter impartially) to put in a negative vote. The atmosphere would be very much clearer regarding this question if the Manufacturers' Association and others who propose to vote or to influence legislation on this question would adopt the plan followed by the AMERICAN MACHINIST and take the testimony of those persons only who have had actual experience with both systems of measurement and can therefore speak with authority upon it. We have published very many communications bearing upon this matter, all from men who have had experience in all parts of the world with both systems in the manufacture of machinery. Their testimony is practically unanimous to the effect that most of the objections to the metric system are based upon difficulties that are purely imaginary. We respectfully submit that where the testimony of men having had such experience is obtainable no other testimony can possibly amount to much, and it is just possible that the manufacturers who object to any advance being made toward the adoption of the metric system are going against their own best interests. Such things have happened, though we do not believe that the heavens will fall if the proposed law fails of enactment any more than they will fall if it passes.

Standard Catalogs or Catalogues.

The note in our issue of November 26 urging the adoption of standard sizes for trade catalogues is reprinted with approval by the AMERICAN MACHINIST, which then inquires why we "continue to waste good space, type, ink and paper by printing *catalogue?* Why is not *catalog* a good standard to adopt also?"

In reply we may say that in our opinion life is too short and important matters too pressing for a technical journal—or any other journal, for that matter—to set up its own standards in the matter of spelling. We adopted the Century Dictionary as our standard for spelling many years ago, and to that arbiter all disputed matters in that line are referred.—*Engineering News.*

This sounds well when read rapidly, but does not bear a closer examination. If we are so busy with "important matters" during our short lives, why is it not best to adopt the shortest and simplest spelling that is authorized? We assure our respected contemporary that we have by no means set up our own standards in the matter of spelling, but on the contrary follow the same authority which our contemporary says was long ago "adopted" by it. Now, by looking in said authority, our esteemed and dignified contemporary will find "catalog n. A recent spelling of catalogue."

The shorter form has been adopted and is recommended by the American Philological Association and also by the Philological Society of England, and is therefore, we judge, fully authorized and proper even for the most conservative and busy technical journal.

We notice that our contemporary still spells another word "*height.*" Regarding this the Century Dictionary says: "height, hight n. The second form is less common, but more correct. There is no reason for the distinction of vowel between *high* and *height.*" No matter how short the life of a technical journal or its editors may be, nor how important the things of which it treats, still a good deal of attention must necessarily be given to mere spelling, and it might be well for our contemporary to take another look at the authority which it many years ago "adopted."

A New Electrical Journal.

Beginning with February 1 the Electric Club, of 735 Penn avenue, Pittsburgh, Pa., will issue a monthly journal to be called the *Electric Club Journal*, which will aim especially to interest young engineers. The new journal is announced as not to be a trade publication of the Westinghouse Electric & Manufacturing Company, although, from its location, much of the material will naturally be drawn from Westinghouse sources. The immediate purpose is stated to be to put in permanent form the papers and discussions that form part of the regular work of the Electric Club, although the publication will not be limited to these papers. The subscription price will be one dollar per annum.

A Correspondence Course in Metallography.

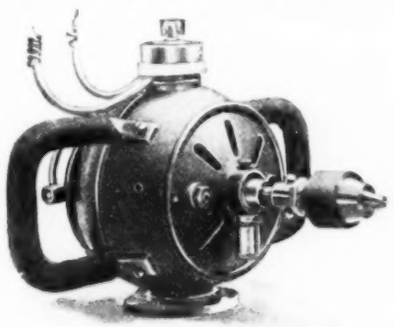
Sauveur & Whiting, metallurgical engineers, of 446 Tremont street, Boston, Mass., announce a correspondence course in metallography. The work will be conducted by the usual correspondence school method and comprises fourteen lessons in the microstructure of pure iron, commercial wrought iron, low, medium and high carbon steel, cast and malleable iron, the thermal critical points of steel and the influence of work and heat treatment on structure. The tuition fee is $35, and an equipment of apparatus necessary for the work, consisting of a microscope with the necessary accessories and supplies for preparing specimens, is supplied for $60 additional.

Captain Pendleton, superintendent of the naval gun factory at the Washington Navy Yard, has recommended to the House Naval Committee that an appropriation of $2,000,000 now and $4,000,000 ultimately be made for the erection of an addition to the Washington gun factory of sufficient capacity to enable the government to manufacture all the guns that will be needed for the new naval vessels now under way. Captain Pendleton presented estimates and figures to show that the erection of such a plant would be economical for the government and among other things said that the private makers of armor plate had in five years made a profit sufficient to pay the cost of their plants with interest. It is said that some members of the committee are, and for some time have been, in favor of the erection of such an addition.

Some New Things.

PORTABLE ELECTRIC DRILL.

This is a small drill made in two sizes—1-20 and 1-10 horse-power—and operating at 1,000 turns per minute, the motor being

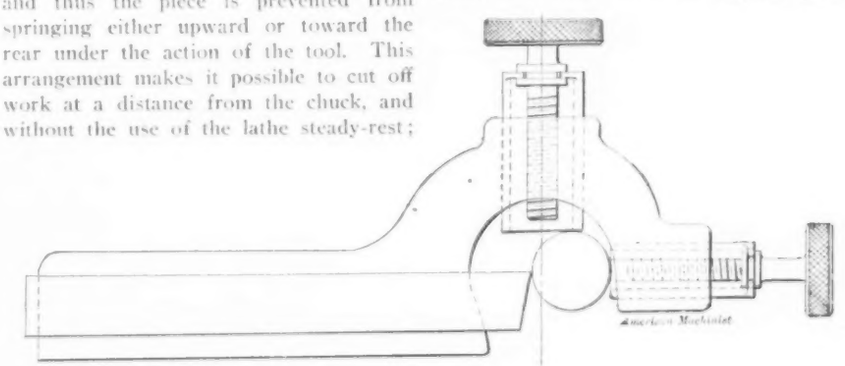


PORTABLE ELECTRIC DRILL.

adapted for use on 115- and 230-volt direct-current circuits. The motor shaft is equipped with a small chuck for receiving drills up to and including 5-16 inch; and two substantial handles are attached to the frame for holding the motor while in operation. This portable drill is made by the Sprague Electric Company, New York city.

CUTTING-OFF TOOL.

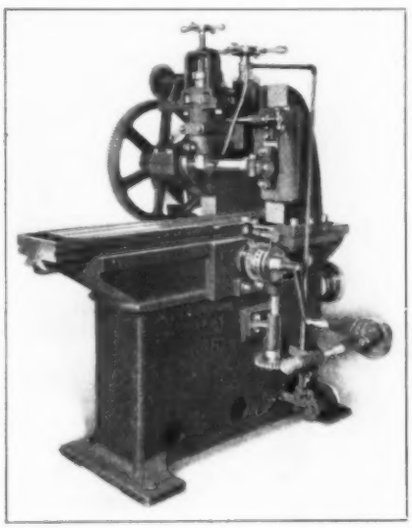
The holder shown carries, in addition to the cutting-off blade, two adjustable rests which are fitted in place, in the manner indicated, at the top and rear of the steel body. The upper or vertical rest is set to bear against the stock before the cut is started, and remains in contact with the rotating piece while the tool is fed in by the cross-slide, the rest of course moving back over the piece as the tool travels toward the center. At the same time the rest at the back is kept in contact with the work by means of its adjusting screw, and thus the piece is prevented from springing either upward or toward the rear under the action of the tool. This arrangement makes it possible to cut off work at a distance from the chuck, and without the use of the lathe steady-rest; and with work so supporting there should be little liability of catching and breaking the cutting-off blade. In the larger sizes the feed screw at the rear is provided with a hand-wheel in place of the knurled head; or, if preferred, a feed lever is supplied doing away altogether with the screw. The tool is made to suit the various sizes of lathe tool-posts, by Jos. Pelletier, Somersworth, N. H.



CUTTING-OFF TOOL.

KEYSEAT MILLING MACHINE.

This machine, though suitable for a variety of milling operations, is designed especially for milling keyseats in shafts, up to 6 inches diameter, and by means of the routing attachment mounted, as shown, in front of the horizontal cutter arbor, will finish with end mills the ends of keyways for feathers and fixed keys. The saddle has a vertical movement on the upright of 10 inches, and the head with vertical



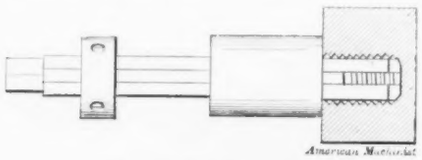
KEYSEAT MILLING MACHINE.

spindle an additional movement in the same direction of 3¼ inches and a cross-adjustment of 3⅛ inches. The platen, which is provided with T-slots and oil channels, is 9 inches wide by 48 inches long, and has 48-inch power feed with automatic release. The main spindle is 3 inches diameter, carries a 20-inch driving gear, and when set at its highest point measures from center to platen 11½ inches, the greatest distance from platen to vertical spindle being 13⅜ inches. The opening through housing is 10⅜x9⅜ inches. The 14-inch driving pulley at the side is driven by a 4-inch belt from a two-speed

countershaft, and the mechanism connecting spindle and feed gears gives for each spindle speed twelve changes of feed. The machine is equipped with oil pump, piping, etc., and weighs about 3,200 pounds; it is built by John T. Burr & Son, Kent avenue, Brooklyn, N. Y.

BROKEN-TAP REMOVER.

With this device the end of a tap which has been broken off in a piece of work may be engaged and screwed out of the hole. The tool consists of a cylindrical holder of the same diameter as the tapped hole and with a squared upper end to receive a wrench. Along the body are formed grooves corresponding with the grooves in the tap and carrying the sliding



BROKEN-TAP REMOVER.

bars by which the tap is engaged, these sliding members being attached at their upper ends to a loose collar by means of which they are moved lengthwise in their seats in the holder. A loose sleeve fits over the holder and sliding rods, and when the tool is applied to a broken tap the sleeve is dropped down close to the work, thus supporting the engaging bars and holding them in the tap flutes while the tool is turned to remove the broken piece. The removers are put up in sets of six, suitable for removing standard taps from ¼ to ⅝ inch. The Atlas Machine Company, Providence, R. I., are the makers.

A GEAR HOBBING MACHINE.

We illustrate herewith what is believed to be the first commercial application of an old principle for the production of generated gear teeth. So far as known, the first to suggest this method of cutting spur gears was Christian Schiele—he of the "anti-friction" curve—to whom was issued for this method English patent No. 2806 of the year 1856. It has been reinvented many times since, and experimental machines based upon it have been constructed. For some reason, however, it has never been worked out on a commercial basis.

The machine is applicable to the cutting of spur, spiral and worm wheels, and when these functions are considered it will be seen to be of remarkable simplicity. Fig. 1 shows it as adjusted for cutting spur gears. The cutter is a hob the longitudinal section of whose teeth represents the rack teeth suitable for engaging with the gears to be cut by it; that is, the sides of the teeth are straight and inclined at an angle corresponding to the angle of obliquity chosen. The same cutter is used for all gears of a given pitch. For cutting spur gears the cutter arbor is swiveled on its head and about a horizontal axis until the

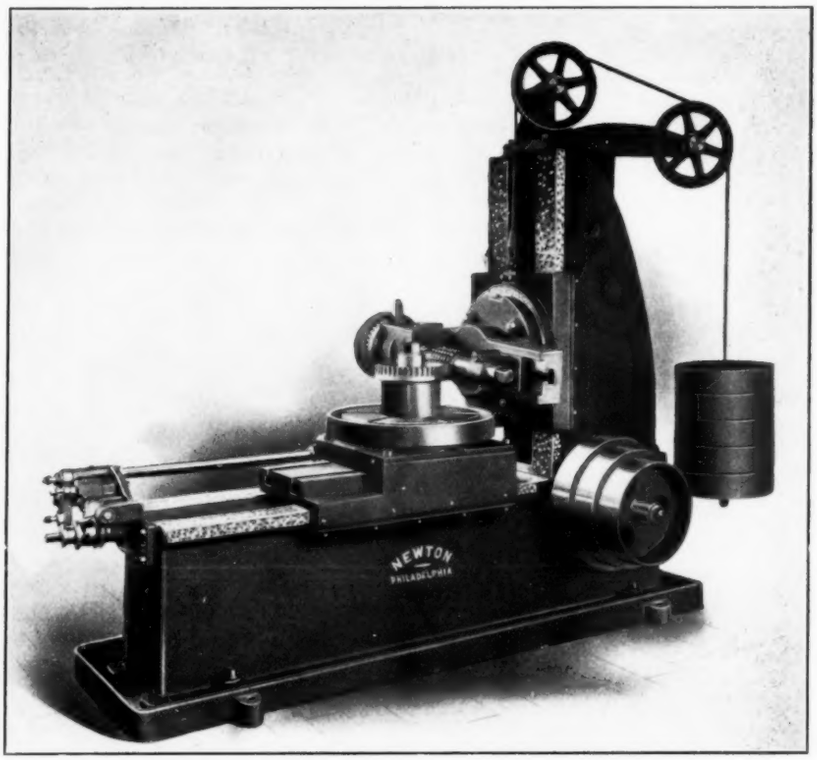


FIG. 1. GEAR HOBBING MACHINE ADJUSTED FOR SPUR GEARS.

inclination of its teeth is rectified. The work and cutter arbors are so geared together that the work revolves past the hob at the rate that it would do were the work completed and the hob a worm in mesh with and driving it. The feed of the cutter is down the post at a slow rate, the cutter beginning by nicking all the teeth as the work revolves below it and proceeding slowly past the blank, cutting the teeth in the manner clearly shown in the illustration and obviously producing not its own profile but a generated profile suitable to mesh with it.

Fig. 2 shows the machine adjusted for cutting spiral gears, the arrangement of

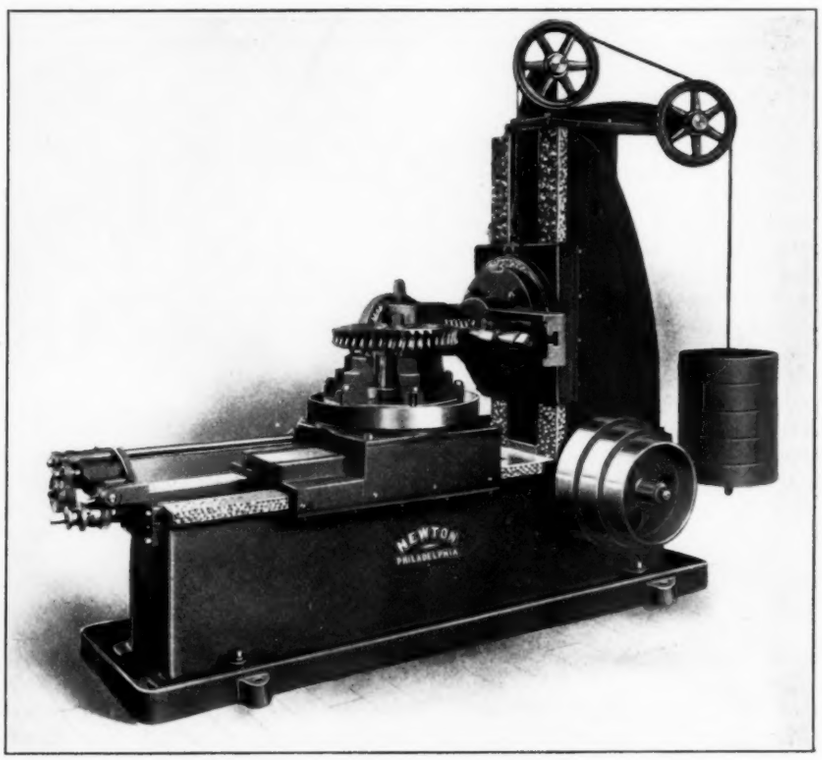


FIG. 3. GEAR HOBBING MACHINE ADJUSTED FOR HOBBING WORM WHEELS.

the driving and change gearing being also shown.

Fig. 3 shows the machine as adjusted for hobbing worm wheels. In this case the vertical feed of the hob is, of course, disengaged while a feed gear at the outer end of the base for forcing the blank directly against the hob is engaged. The machine is the product of the Newton Machine Tool Works, of Philadelphia, Pa.

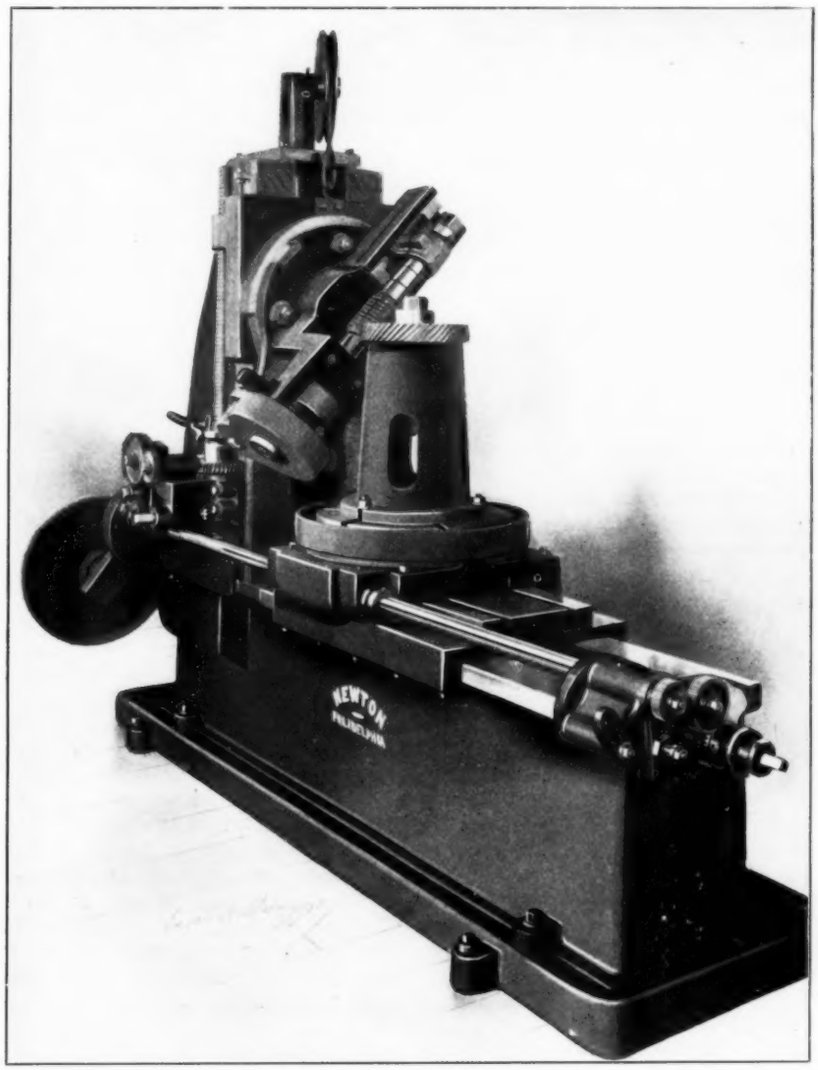


FIG. 2. GEAR HOBBING MACHINE ADJUSTED FOR HOBBING SPIRAL GEARS.

Technical Publications.

"The Mechanical Engineer's Reference Book." By H. H. Suplee. 834 4x6½-inch pages with numerous illustrations and tables. J. B. Lippincott Company, Philadelphia and London. Price $5, or with marginal thumb index, $5.50.

Of the value of no class of books which come to our desk is it so difficult to form a just estimate as of engineers' pocket books, since the only test of such books lies in actual use. Our impressions of this latest addition to the growing list of such books is, however, wholly favorable. We notice especially some highly useful additions to the usual list of tables. Of these the first is a factor table of numbers up to 9,599, by which the factors can be determined at a glance, or, if the numbers are prime, that fact is also shown in the table. The tables of trigonometrical functions, both natural and logarithmic, are also much more complete than in most pocket books, many of which strangely neglect the former, which, to the mechanical engineer, are of far greater use than the latter. The conversion tables between the English and the metric systems of weights and measures occupy twelve pages, and are the most complete we have seen. The tables of standardized constructional elements are also very complete, and include the recent standards of the American Society of Mechanical Engineers for pipe flanges and unions, together with many house standards that are not usually given. A section is devoted to machine design, in which the more frequently occuring machine details are treated after the manner which has been made familiar by the books of Reuleaux and Unwin. A section is devoted to Works Management, in which the elements of cost accounting and of allied subjects are presented. The index is full, comprising thirty-one pages; but the quality and sufficiency of this very important part of such a book can be determined only by experience.

"Worm and Spiral Gearing." Second, revised and enlarged edition. By F. A. Halsey. 90 4x6-inch pages, 26 illustrations and 18 folded tables of spirals which may be cut on the Brown & Sharpe universal milling machine. D. Van Nostrand Company, New York. Price, 50 cents.

The second edition of this book contains a number of new features, among which are an abstract of the experiments on worms by C. Bach and E. Roser, which were published in these columns recently, and analytical and graphical solutions of the special case of spiral gears of equal diameters. The most notable addition, however, is the table of spirals mentioned above. This list, which was furnished by the Brown & Sharpe Manufacturing Company, comprises over 8,000 spirals, and is the first complete list of the kind that has been published.

"Fowler's Electrical Engineer's Year Book." 539 3¾x6-inch pages. The Scientific Publishing Company, Manchester, England. Price, one shilling and sixpence and two shillings and sixpence, according to the binding.

This is one of the cheap and excellent pocket books which are peculiar to England. The present issue contains many revisions and additions, and, like the former ones, is worth many times its price.

Personal.

G. L. H. Arnold, mechanical engineer with the Atlas Portland Cement Company, Northampton, Pa., has resigned.

E. Stutz, of 54 Front street, New York, will lecture on Alumino-Thermics at the Franklin Institute, January 20, and at the Massachusetts Institute of Technology, February 26.

By invitation, Frank F. Woods, treasurer and general manager of the S. A. Woods Machine Company, Boston, Mass., gave a talk last month on "Wood Working Machinery" before the Mechanical Club of the Scientific School of Harvard University.

Irving H. Reynolds, formerly chief engineer of the Allis-Chalmers Company, is now connected with The William Tod Company, of Youngstown, Ohio, as consulting engineer. In addition to their existing lines of machinery, the Tod Company intends to go into the building of the Reynolds high-duty crank and flywheel pumping engines, hoisting engines, etc.

L. Tomlinson, one of the most famous of ship's engineers, recently completed his last voyage as engineer of the "Campania" of the Cunard Line. He retires on a lib-

eral pension after fifty-one and a half years of service with the company. His greatest feat was the piecing out of the broken shaft of the "Umbria" eleven years ago. It is estimated that he had traveled 2,125,000 miles.

N. S. Braden, formerly manager of the Westinghouse Electric & Mfg. Co.'s district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company, Ltd., and assumed the duties of that office on January 1, 1904. Mr. Braden succeeds the late Thomas C. Frenyear, who died on December 10 of last year. Mr. Frenyear's office was at Toronto, but Mr. Braden will make his headquarters at Hamilton, Ontario.

Obituary.

Jonas B. Aiken, who operated a machine shop at Manchester, N. H., several years ago, building knitting machines, died at Jacksonville, Fla., January 5, seventy years old.

Our contributor, C. H. Norton, in a letter to the editor gives us the following account of the life of his uncle, Gilbert B. Norton, who died at Manchester, Conn., December 24, aged seventy. He was born in South Glastonbury, Conn. At the age of fourteen he was apprenticed at the Union Plaid Mills at Manchester. Later he became foreman of the machine shop of the works. He was for many years the foreman machinist at the Cheney Bros. Silk Mills at South Manchester, and had much to do with the improvements in silk machinery in his time. In 1886 he built a shop at Manchester, where, until three years before his death, he carried on a machine jobbing business. He belonged to a family of machinists; his father was a foreman machinist in the early days of the cotton industry of Connecticut, and is said also to have made the first "dry paper" machine in this country. His brother William was superintendent of the Union Plaid Mills at Manchester, his brother Noah was master mechanic of the Seth Thomas Clock Company for forty years. He leaves five sons, all of whom are machinists. John, the oldest, is in charge of the experimental department of the American Graphophone Company at Bridgeport, Conn. Charles, Fred and Marshall comprise the Norton Electrical Instrument Company, of Manchester. Arthur W. will continue the business of his father. Mr. Norton was a veteran of the Civil War, serving with the First Connecticut Heavy Artillery.

George W. Stroman, superintendent of the Bethlehem Steel Company shops No. 2, died suddenly December 31, forty-three years old. Mr. Stroman was a native of Pennsylvania. The death of his father when he was ten years old, the eldest of eight children, left the family in abject poverty. He first followed the canal and later was employed in a cigar factory. Twenty-two years ago he got employment as a laborer in the shop of which he ultimately became the head. After several months at laboring work he became an apprentice and regularly learned the machinist's trade, and, showing exceptional ability as a workman and winning the confidence of his superiors, he was gradually advanced to the position of night superintendent of No. 2 shop. Serving eight years as night superintendent, he was then promoted to the position he held at the time of his death, that of superintendent of the largest department of the Bethlehem Steel Company, its mammoth gun shops, more commonly known as machine shop No. 2. He was an excellent disciplinarian as well as an exceptional mechanic, and the output of the shop more than doubled while it was under his charge. In 1902 just 29,000,000 pounds of finished material were produced, and in 1903, closing with the day of his death, the amount was 36,000,000 pounds. In recognition of the exceptional total of 5,000,000 pounds for the month of December when but 4,000,000 had been expected, he had made arrangements for a New Year's dinner for all hands, "Dress Suits Barred." Mr. Stroman was a prominent and influential man in the Bethlehems, having been Chief Burgess for three years.

Commercial Review.

NEW YORK, Monday, Jan. 11, 1904.

The opening of a new year is always remarkable for the discussion indulged in, as to the trade possibilities it is likely to offer. From this standpoint the year which has entered in on its course, may be said to be the recipient of greater attention than any that has preceded it, for, among other reasons, because of the notable contribution to history its predecesor made, and which has left conditions unlike any the business world has ever been confronted with.

Machinery men have found the outlook in their line for the present year, a most fruitful source of discussion. While the opening of 1903 found all of them a unit in the belief that the era of prosperity they had been enjoying for three years or so prior was going to continue—and for at least three months they saw everything going that way, with subsequent developments we noted in a previous issue—it must be said that the opinions expressed by them as to the outlook for their business for the present year, have no such solidity, for which the miscellaneous legacies of the old year are solely responsible.

In other words, machinery men in commenting on the outlook for them, are particularly anxious to know what will be the course of the money market for the year, and what effect the presence of a Presidential contest will have on general business. They had not to face factors like these at the opening of 1903, for money was plentiful, and the advent of a Presidential contest was not even a matter of passing reference. But now they are considered of great importance, and upon their course machinery men say rests the question whether or not 1904 will be a good or bad year for them.

The advices which machinery merchants have concerning the availability of money for commercial and industrial enterprises, are all of a most hopeful character. In their intercourse with railroad companies and manufacturing concerns, whose prospective plans calling for the installation of machinery were called to an abrupt termination during 1903 because of the stringency in the money market, they find that the promoters of these expect to be able to go ahead with them in the near future. Machine-tool men, for example, have been informed that the successful flotation of securities by railroads recently, will soon make itself felt in purchases for new equipment, while manufacturers of engines, boilers and electrical machinery have advices that industrial enterprises whose development means some good orders for them, have now less to contend with than they had at any time since their inception, particularly as regards the necessary funds to push them to completion. This information is corroborated by the engineers who were engaged to draft the plans, and by structural material men who are after the contract to supply the necessary steel.

Among machinery men in the East, the consensus of opinion is, that they have little or nothing to fear, from the Presidential election. Several weeks ago, we made known the fact, that they thought it would be an object of interest to the politicians alone, and they still say so. The statements they make in this connection are identical with those set forth by a magazine writer, and which are as follows:

"Of the two issues in national elections that have operated most disastrously on American trade in the recent past, the free coinage of silver and the tariff, the former is as dead as a coffin nail; the latter is not likely to cut any considerable figure in the campaign of 1904. It was unquestionably a potent factor in precipitating the "panic" of 1893 by reason of the widespread uncertainty as to just what would be done with the McKinley law. The coming contest over the Presidency can hardly be said to menace business beyond the customary absorption of popular interest that it temporarily involves."

In an article dealing with the business outlook for 1904, *Dun's Review* takes the same view of the matter, as will be seen from the following: "There is a fear of political difficulties, but this is frequently a nightmare. It has to be demonstrated that a Presidential election *per se* is a material drawback to industrial activity. It certainly was not in 1892 or in 1880. The fact that some Presidential years have been periods of lessened activity has been a mere coincidence. A Presidential election has no very powerful effect on general business unless some issue, such as the

currency or the tariff, is raised, which has some direct reference to mercantile affairs, and there is every reason to believe that neither question will play any part in the campaign of 1904."

In machinery circles, considerable satisfaction is expressed with the improvement that has recently taken place in the pig-iron situation. It is contended that the stoppage of the long depression in the latter, shows that general business conditions are getting better. News comes from Birmingham, that the disastrous competition among Southern furnacemen, following the dissolution of the Southern Pig Iron Association, will soon be ended by the revival of the latter, with a larger number of furnaces represented in its membership, and with a plan in operation that will insure uniform prices, with selling at concessions made impossible without detection. The plan calls for the production of bills of lading at a central office.

During the past week receivers were appointed for the International Fire Engine Company, which has plants at New York, Baltimore, Chicago, Cleveland, St. Paul, Elmira, and other places. The original capital stock of the company was $9,000,000, but recently this was reduced to $3,000,000. The receivers were named after a statement was made to the courts that the company had liabilities of $347,274 and assets of $92,250. Counsel for the company make the following statement:

"The company has for some time past been embarrassed for cash capital, and its stockholders have entered into a plan of reorganization intended to provide the amount necessary to pay all creditors. Owing to the importunity and pressure of certain creditors it was found necessary to take this step to protect and preserve the assets of the company pending reorganization.

"The plan of reorganization has been declared effective and has been approved by over 80 per cent. of the preferred stockholders and over 68 per cent. of the common stockholders. The appointment of the receivers will in no way retard or affect the plan of reorganization, which will be carried out in due time. The committee is preparing to make its first call under the plan for the cash subscriptions."

The statement that the company was handicapped for the want of adequate cash capital, explains one of the potent reasons why so many industrial corporations have gone into liquidation recently. When some of these were organized, they were better known at the engraving establishment than at the bank. In other words, they had plenty of securities to offer, but in actual cash they were as poor as the proverbial church mouse, by comparison. It is not alone of concerns directly connected with the iron and steel industry, that this can be observed, although it must be said that they are pretty well represented in the quota. Yet when some of these companies become entangled in financial difficulties, the excuse put forth the most is that bad business was responsible, when as a matter of fact that was only a subsidiary cause at best to the controlling one, of overcapitalization with its numerous concomitant evils.

CHICAGO MACHINERY MARKET.

Perhaps the most interesting feature of the Western iron-working machine-tool trade is the considerable number of small orders that are given by repair shops, starting up throughout the richly endowed agricultural regions. Some of these shops buy second-hand tools and some of them want new machines. There is corroborative evidence beyond measure that the financial condition of the Western farmer is above par. He has in recent years been buying machinery to an extent unknown before, including gas engines and a whole array of improvements to which his attention has been called only in recent years. Some of this machinery gets out of order easily and this creates the need of the repair shop. Of course the value of the repair shop from the standpoint of the tool builder is mainly prospective, for the sale of several small tools does not make an especially gratifying order. But many of the present manufactories of large dimensions started as repair shops, and it is only a step for the machinist to cross over from repair work exclusively to manufacture.

It is also a notable fact in connection with these new shops that the proprietors almost invariably have the cash with which to equip their modest plants. There have been periods heretofore when in almost the same manner there was a drift of activity towards the starting of numerous small shops. But the prospective proprietors then bought their tools on credit, paying perhaps 20 or 25 per cent. cash and obtaining many months' time for full completion of payment. From some source the beginners now have the ready capital to fully pay for the equipment purchased.

There does not appear to be much trade of a large character in machine tools, nor has much business of that kind been closed within the past month. If there has been carried over into the new year from 1903 much prospective trade it has not as yet materialized. But December was not an unsatisfactory month on the whole. Some of the local houses say its trade exceeded that for November, and that if the months of 1904 average as well, there would be no losses this year. Speaking of the difference between the present trade and that of a year or two ago, the representative of a large machine-tool house says that two years ago the country buyer, who wanted some machine tools, would have made a trip to Chicago, had a good time, looked around and discovered what was new. Now he stays at home and orders by mail the exact standard tools he needs.

There are sellers of wood-working machinery who say there is the same moderate activity in that branch of the trade that is noticed in iron-working tools. But there are others who report what may be called an active demand. They say it comes mainly from the sash and door factories and from other manufacturers, supplying the building trades. The reports emanating from these buyers are to the effect that prospects for building this coming spring are bright and that it will equal if not surpass that of 1903.

Quotations.

NEW YORK, Monday, Jan. 11, 1904.

New York prices for Northern and Southern irons for nearby delivery are, nominally, as follows:

Northern:	
No. 1 X	$15 25 @ $15 75
No. 2 X	14 75 @ 15 50
No. 2 plain	14 25 @ 15 00
Southern:	
No. 1 Foundry	14 00 @ 14 50
No. 2 Foundry	13 25 @ 13 75
No. 3 Foundry	12 75 @ 13 25
No. 4 Foundry	12 25 @ 12 75

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.40c. upward in carload lots. Soft steel bars, 1.45c. upward.

Tool Steel—Base sizes—Good standard quality, 6¾ @ 7c.; extra grades, 13c. and upward.

Machinery Steel—Base sizes—From store, 1.80c.

Cold Rolled Steel Shafting—2.65c. from store for base sizes.

Copper—Lake Superior ingot, 12¾ @ 13c.; electrolytic, 12⅝ @ 12⅞c.; casting, 12½ @ 12¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 29¼ @ 29⅝c.

Pig Lead—4.40 @ 4.50c. for spot.

Spelter—5.00 @ 5.10c.

Antimony—Cookson's, 7 @ 7¼c.; Hallett's, 6⅛ @ 6¼c.; other brands, 5⅝ @ 5¾c.

Lard Oil—Prime City, 61 @ 63c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The Rheems (Pa.) Canning Company will build a plant.

Kansas City is trying hard to get the Missouri Pacific shops.

The Grand Rapids (Mich.) Table Company expects to build an addition.

The Kalamazoo (Mich.) Stove Company will double its plant this year.

The works of the Pennsylvania Shovel Company, Corry, Pa., have been burned.

E. Teel & Co., carriage manufacturers, Medford, Mass., intend to erect a new building.

J. C. Van Auken, of White Cloud, Mich., is promoting a canning factory in Coopersville.

The Adam steel and wire mill, Joliet, Ill., has been burned. It will be immediately rebuilt.

The Mertztown (Pa.) Paint & Ochre Company will enlarge its plant and put in larger engines.

It is stated at Glasgow, Ky., that Vaughan & Boucher will engage in the manufacture of brick.

The American Automobile & Power Company will build an automobile factory in Sanford, Me.

Mauser Silver Company, of Fifteenth street, New York city, is erecting a large plant at Mt. Vernon.

The John W. Craw Laundry Machinery Company, South Norwalk, Conn., thinks of enlarging its works.

The plant of the Fairbanks Steam Shovel Company, Marion, O., is expected to be in operation shortly.

Bids have been taken by Indiana University, Bloomington, Ind., for the construction of a power plant.

The Baum Separator & Machine Company, Inc., Reading, Pa., is about to open a branch factory in Manheim.

Ernest L. Hill and J. F. Weathers will form a copartnership and manufacture refrigerators at Columbus, Ga.

The Fredonia (N. Y.) Preserving Company will increase its plant at Wilson, N. Y., by two buildings, 40x100 feet.

I. Stephenson Company, lumber, etc., of Escanaba, Mich., is considering whether to build a box factory at Wells.

Messrs. Tannahill and O'Dell, of Lima, O., brick manufacturers, may establish a brick-making plant at Bowling Green.

A plant of the Morning Star Manufacturing Company, threshing machinery, engines, etc., Napoleon, O., has been burned.

The Bemis Brothers Bag Company, of St. Louis, Mo., and elsewhere, expects to build a plant at South Seattle, Wash.

The Central Consumers' Company, Louisville, Ky., expects to build an ice plant to have a capacity of 50 tons a day.

The Colorado Fuel & Iron Company proposes to establish a chain of warehouses reaching from Seattle to St. Louis.

The Ohio Ceramic Engineering Company, Cleveland, O., manufacturer of clay-working machinery, has bought three acres for a plant.

A cloth-making mill to employ about 300 hands will be built at Passaic, N. J., by a German concern represented by George Ruhlig.

The Camp Manufacturing Company's plant, Franklin, Va., has been partly burned. The fire originated in the engine-room of the planing mill.

The Clinton (Ia.) Separator & Engine Works intend to erect a new building, which will enable them to add largely to their working force.

The New Home Sewing Machine Company, Orange, Mass., will erect in the spring a building, 250x60 feet, four stories. The foundation is in.

It is authoritatively denied that W. Jessup & Sons, Ltd., of Sheffield, England, have been looking for a factory site in Hamilton, Ont., as stated in No. 1.

The Schenectady Artificial Ice & Storage Company is securing a site for a building. The company's office is in the Fuller block, Schenectady, N. Y.

It is hoped that the J. C. Hubinger Bros. Company's big cereal plant at Keokuk, Ia., which was badly damaged by fire a few days ago, will be rebuilt.

The Lynn (Mass.) Realty Company is preparing to build a factory having floor space exceeding 190,000 square feet, for shoe manufacturing purposes, etc.

The National Iron Works, St. Louis, Mo., are building a new plant. We think that it is located in East St. Louis, Ill. The plant will make small castings and employ many men.

The six-story building at Fifth and Oxford streets, Philadelphia, occupied by James H. Dillington & Co., manufacturers of bobbins and shuttles, has been badly damaged by fire.

Wm. A. Rogers, Ltd., cutlery and silver-plated ware, Niagara Falls, N. Y., is starting to make improvements to a plant there formerly occupied by the Carter-Crume Company.

Andrew Hayes, living at or near Buskirks, N. Y., has patented a draw bolt for shackles on vehicles and other purposes. He is having it manufactured by contract and hopes later to establish a plant to make it.

The Commercial League, Pine Bluff, Ark., has been investigating a proposition of Messrs. Ward, Hill and Vooris, Indiana promoters, who proposed to build a $100,000 hardwood manufacturing plant in Pine Bluff.

The Standard Foundry Company, of Hartford, Conn., has been incorporated. The president is Allen C. Bill. We understand that it will operate the plant of the Carleton Foundry Company, on Faience street.

J. W. Hambrick, of Huntington, W. Va., may establish in Parkersburg an industry to employ 70 to 100 men. He is also said to be starting up a plant in Cincinnati to manufacture automobiles under his own patent.

The Howard Iron Works, a long-established concern of Buffalo, N. Y., is completing a new foundry, which will be followed by new machine and erecting shops. It is making the electric elevator business one of its leading lines.

The Eagle Manufacturing Company, manufacturer of portable gas engines and implements, Appleton, Wis., will build a new plant next spring, comprising four large buildings and employing several hundred additional men.

E. B. Cunningham, representative of the Coaleo Fuel Manufacturing Company, has been at Logansport, Ind., in conversation with the members of the Commercial Club, endeavoring to secure a site there for his company.

P. H. Mack, who has been identified with the oil well supply shops, Bradford, Pa., was to leave, a few days ago, for Independence, Kan., to engage in the business there for himself. A machine and blacksmith shop will be erected.

The new factory building at Washington, Ind., of the Cincinnati Seating Company, which was removing its plant from Harrison, O., has been blown down by a storm. It was a brick structure, 90x180 feet, five stories. It will be rebuilt.

Contracts are about being awarded for the construction of an ice plant for the Hudson Consumers' Ice Company, of Hoboken, N. J. It is co-operative and is capitalized at $500,000. F. William Bender is president; Phillip J. Kreutzig, secretary.

J. R. McWane, of Richmond, Va., was recently expected in Birmingham, Ala., to begin work on a steel casting plant, which he will erect there or in one of the suburbs. The plant will cost in the neighborhood of $30,000. The company will be incorporated at $50,000.

It is stated that the Rawson Electric Company, Elyria, O., has sold its manufacturing interests to the Deene Manufacturing Company, of Chicago, Ill., who will make electrical supplies. Their building will be 180x106x58 feet, two stories. The work of construction was to commence January 1.

When the plant at Lockport, N. Y., of the Holly Manufacturing Company, pumps, etc., is vacated by the removal to Buffalo of the machinists, who alone have not been transferred to Buffalo, the deserted Holly buildings are to be occupied by the Colonial Electric Company, of Dayton, O., an electric machinery manufacturer.

J. Davis Sisler and Perlee C. Sisler, his son, of Wilmington, Del., are interested in the Taite & Sisler Company, which has been formed with a capital of $200,000. The plant will be located in Philadelphia. They will manufacture decorated, gold lacquered and plain tin cans, boxes and containers and sheet metal specialties.

Plans have been made for improvements for the Elgin (Ill.) National Watch Company, costing about $1,000,000. They include an addition, three to seven stories, to the present factory and power plant and a new factory and office structure, four and five stories, 575 feet long, 30 to 150 wide, with a clock tower 175 feet high.

A Spartansburg, S. C., firm has prepared plans in behalf of J. S. Bailey & Co., of Waycross, Ga., for developing water-power on the Little Tennessee River in Swain County, N. C., to furnish 40,000 horse-power. It is proposed to transmit the power by electricity for various industries, and the first mill to be built will be a cotton factory.

The Hudson River Electric Power Company, of Queensbury, N. Y., has been incorporated at Albany. It proposes to build a dam at Conklingville, form a reservoir larger than Lake George to maintain the upper Hudson in the dry season, and distribute electric power as far West as Utica and Syracuse and as far South as Hudson.

There has been issued a prospectus of the Orrington Railroad & Peat Fuel Company, of Bangor, Me. The plans include, in part, a peat fuel factory with an annual production of 15,000 tons, a power plant and an electric railroad from the works to the city of Brewer. Herbert A. Harris, Reading, Mass., is president. Fred T. Dow, Bangor, Me., is engineer.

With the principal office in Elmira, N. Y., and a manufacturing plant in the natural gas belt of West Virginia, the Baldwin-Travis Company, a $1,500,000 corporation, will manufacture glass milk bottles. The company controls the use of the Owens bottle machine. The output is to be handled by the Thatcher Manufacturing Company, of Potsdam, N. Y.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 72.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

J. Gregory, 140 W. 23d st., New York, specialist in small machine designing.

Machine design and drafting. R. G. Berlin, M. E., 123 Liberty st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Electrical and mechanical machinery designed. C. E. F. Ahlm, Williamson Bldg., Cleveland, O.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—No. 1 universal miller, complete, in good order; must be cheap. F. 1, 936 Monadnock Bldg., Chicago.

Pattern letters and figures for wood and metal patterns, tablets, etc.; also steel stamps. Knight & Son, Seneca Falls, N. Y.

Special machinery for reducing labor and increasing profits, designed and perfected. C. E. Sargent, M. E., 1214 Manhattan, Chicago.

M. Neumayer's Engineers' Handbook of Details and Machinery, $3.50. Write for pamphlet. 243 Southern ave., Cincinnati, and 508 Tenth st., Brooklyn.

Wanted—Apprentices to take up course in mechanical, patent office and electrical draft-

Running Fit Limits.

BY HENRY HESS.

A number of years ago, while starting up the manufacture of medium and heavy machine tools, it was decided to adopt a systematic set of limits for reamed holes and running fits. There is nothing specially new in that in this country, although it is by no means as general for medium and heavy machine building as it should be; but in Germany, where the new works were located, limit gages met with but slight appreciation outside of establishments engaged in the manufacture of small arms, sewing machines and similar articles. In larger works the general practice was to consider the journal diameter as fixed and to vary for the character of the fit in the hole, contrary to our general way of working.

In the standards adopted the bored or reamed holes were allowed to vary most from the nominal diameter on the plus side. The variation permitted the maker of the reamer was about one-third that between the upper hole limit and the nominal size.

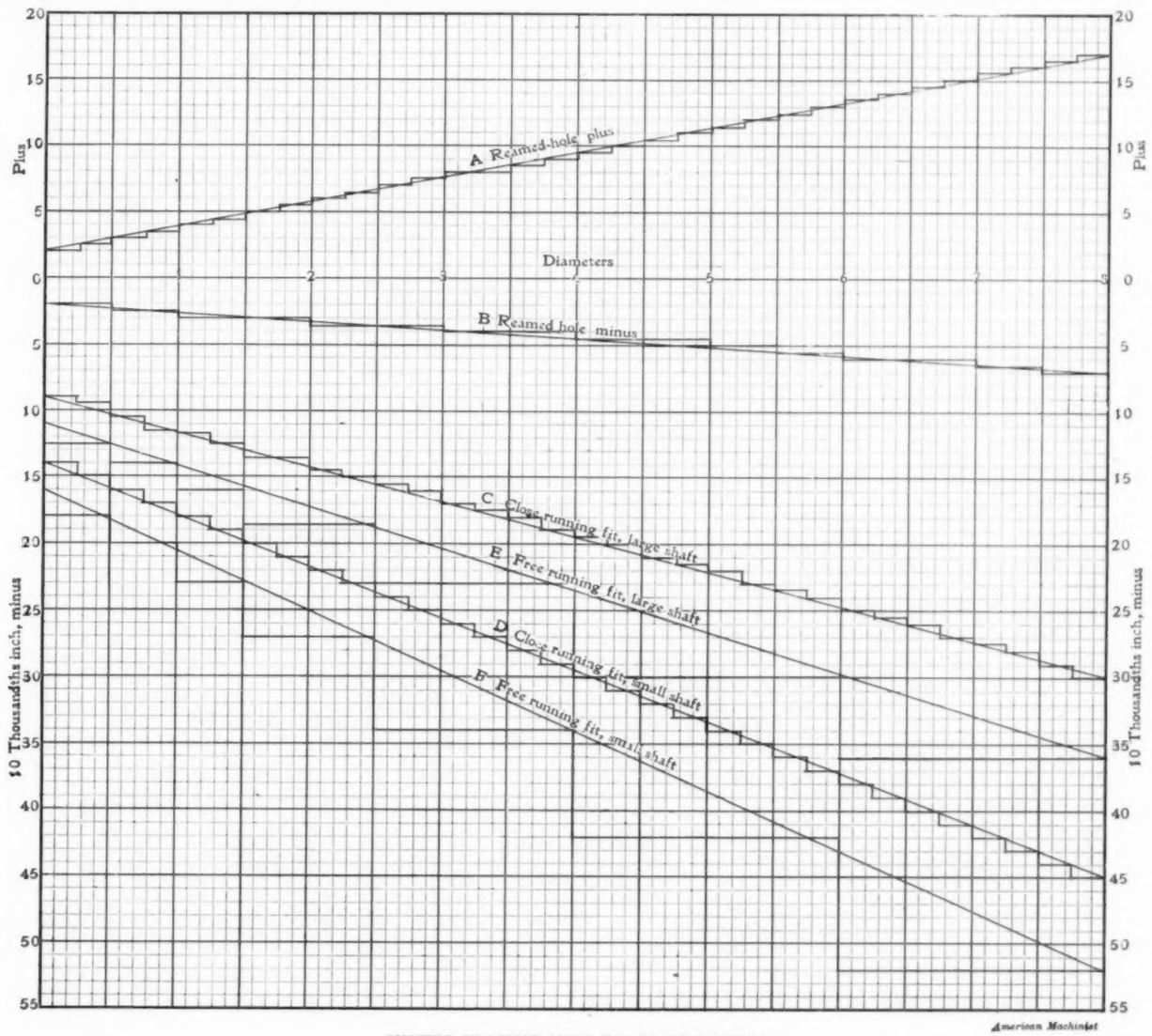
On the diagram these limits are shown for all sizes up to eight inches diameter; the horizontal line marked *O* is marked also with the various diameters; the upper stepped line *A* gives the largest diameter permitted, and B, the one next below, the smaller bore limits; the vertical distance between the two stepped lines measures the total variation permitted.

The limits are all given in ten thousandths of an inch on the vertical scales at the right and left sides.

At first only one character of running fit was allowed with limits as given by lines *C* and *D* and marked "close running fit." Experience soon demonstrated that for all journals except a few requiring very accurate fitting, such as main spindles, these fits were closer than really was necessary, and were moreover likely to cause trouble from seizing unless very carefully oiled and kept clear of gummed oil; that being the case and a larger limit also having the advantage of cheaper production, limits for "free running fits" were adopted as given by the lines marked *E* and *F*.

In illustration, take the one-inch sizes from the diagram: The nominal one-inch hole is allowed a total variation of seven points—each point being one ten-thousandth of an inch—of which variation four points are plus and three minus. The reamer when new was permitted a reduction of two points from the larger limit; that gave a range of reamer wear of from five to seven points. The close running fit is from eleven to seventeen points smaller than the nominal inch size. The least difference between shaft or journal and bore is eight points as read off between the stepped lines *B* and *C* and the greatest twenty-one points between lines *A* and *D*. A free running fit is smaller than its nominal one inch by from fourteen to twenty points, a variation of six points: the difference between journal and bore diameters—lines *B* and *E* and *A* and *F*—ranges from eleven to twenty-four points.

Several years' experience with these limits showed them to be well adapted to the class of machinery built. While those used were actually in the metric system of measurement the diagram gives the equivalents in inches very closely.



SYSTEM OF LIMIT SIZES FOR REAMED HOLES.

Power Absorbed in Drilling in Various Metals at Various Speeds and Feeds.

The accompanying illustrations give the very valuable data of Mr. Norris in the form of diagrams, both directly from the tables which we published last week and as modified for better comparison.

Fig. 1 gives the data of Mr. Norris's Table 2 plotted directly. In the experiments here recorded the speed was constant for each size of drill, but varied between the different drills, while each drill was tested under varying feeds. The horizontal scale gives the feeds in thousandths of an inch per revolution, and the vertical scale gives the horse-power. Two sets of curves have been drawn, of which the upper full line set shows the gross horse-power and the lower dotted set shows the horse-power per cubic inch of metal removed per minute. The curves have been drawn as fair averages of the observations, with a single exception. The horse-power for the 1¼-inch drill under .0286 inch feed is abnormally high, as will be seen, and hence it has been disregarded, the curves drawn for this drill being a smooth curve through all the other data. There is increased reason for doing this over what appears from Fig. 1, as will be seen when we come to discuss Fig. 3.

Fig. 2 gives the data of Mr. Norris's Table 3, in which the feed for each drill was constant, while the speed was varied. As before, two sets of curves have been drawn, of which the full line set relates to the gross horse-power, while the dotted set relates to the horse-power per cubic inch of metal removed per minute.

Figs. 3 and 4 represent, on the three co-ordinate system, the results of the two sets of curves of Fig. 1, but modified in accordance with Fig. 2 to give these results for a constant circumferential speed of 30 feet per minute for all sizes of drills. That is, factors have been taken from the curves of Fig. 2 by which to multiply the readings from the curves of Fig. 1 in order to reduce them to a constant circumferential speed of 30 feet per minute. Fig. 3 thus gives the full-line curves of Fig. 1 raised or lowered, as the case may be, to make them read for this constant speed, and similarly Fig. 4 gives the dotted-line curves of Fig. 1 modified in the same way.

Inspection of Fig. 3 will show the additional reason for neglecting the abnormally high reading of the horse-power for the 1¼-inch drill under .0286 inch feed. Fig. 1 shows that this reading is out of step with the others in the relation there shown between feed and horse-power. Were this reading plotted in Fig. 3, it would be seen to be also out of step with the others in the relation between the diameter of drill and horse-power, a fact which gives additional reason for discarding it. Even after discarding this reading, the right-hand end of the curve for the 1¼-inch drill of Fig. 3 seems to be higher than it should be, though we have no sufficient warrant for lowering it. The curves of Fig. 4 will be seen to be extremely concordant in every way.

Table 5 is plotted in Fig. 5, which is self-explanatory.

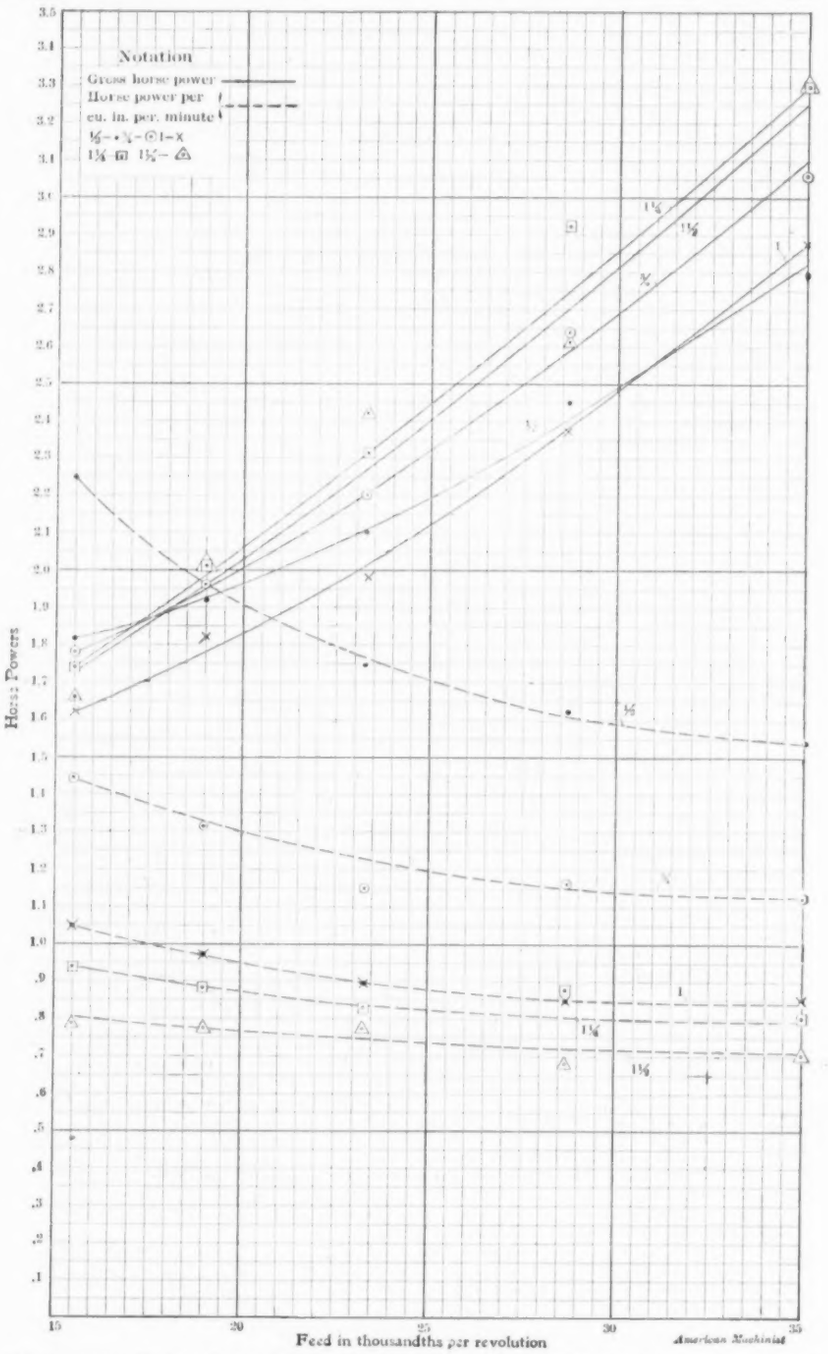


FIG. 1. RESULTS OF TESTS UNDER VARIABLE FEEDS, THE SPEEDS REMAINING CONSTANT FOR EACH SIZE DRILL.

Laboratory vs. Shop.

BY ROBERT H. SMITH.

At page 1200, Vol. 26, was published a letter by our mutual friend, Prof. M. P. Higgins, of Worcester, Mass., in which he criticises an article in the *Tech* entitled "Mechanical Laboratories vs. Workshops." Kindly allow me to say that the object of this article in the *Tech* was to explain why the Massachusetts Institute of Technology changed the name Workshops to Mechanical Laboratories, Machine Shop to Machine-Tool Laboratory, Forging Shop to Forging Laboratory, etc. The principal reason for this change of name is not to change the name of the real shop or workshop, as Professor Higgins assumes, but to distinguish between teaching and manufacturing.

A shop—or workshop, as we commonly use the term in America—is a manufacturing establishment where labor is applied to produce things industrially and for pecuniary profit. To this end everything else is subordinated, so that to acquire in such a place a knowledge of technical processes is necessarily slow work. In the great

majority of cases the workman in manufacturing establishments is self-taught, or nearly so. A boy enters the shop to learn a trade. He is made to sweep and to do the crudest kind of work. After a few months he may be allowed to do rough chipping or filing, or to operate a machine which is adjusted for him and which he does not understand. In this manner he begins to learn a trade, without instruction and without system. This method presupposes that the boy will acquire information and skill by observing what is done about him. His attempts to learn are ventures, often disastrous and discouraging. If he has relatives or friends connected with the shop, he may obtain exceptional advantages. In any case, the amount of knowledge he can obtain depends upon his own thought and calculation and upon accident. The teaching results of manufacturing are small. It takes a number of years to acquire even an elementary knowledge of any one branch of the mechanic arts. Manufacturers are beginning to recognize these facts and would gladly alter the conditions, were it possible. Some have, in a measure, improved the opportunities of their beginners by placing them in charge of a competent man, other than the foreman, who will supervise their work, and give such instruction as their manufacturing processes permit. Schools that are endeavoring to supply the deficiencies of the shop owe a debt of gratitude to those manufacturers who have given them substantial encouragement by supplying tools at a great reduction in price or in many cases by donating them outright.

Again, on account of modern methods of specializing the processes of manufacturing, where apprentices have to produce hundreds of pieces of the same kind, the opportunity for acquiring principles and learning to do a variety of work has become less and less, and the true apprentice system is nearly extinct with no prospect that it can ever be successfully resurrected. The pioneers who introduced these arts into the curriculum of schools and colleges were far-seeing enough to read the "writing on the wall," to anticipate this, and as a remedy for this deficiency to establish schools with departments called shops or workshops, nominally to teach these arts, but which largely used manufacturing methods—that is, endeavored to teach the subject by building machines or furniture, or by constructing apparatus for the school. These methods, in some cases supervised by an efficient instructor, were a slight improvement over the shop method, but in most cases they were inferior, as the range of work was limited and the opportunity for variety was much less.

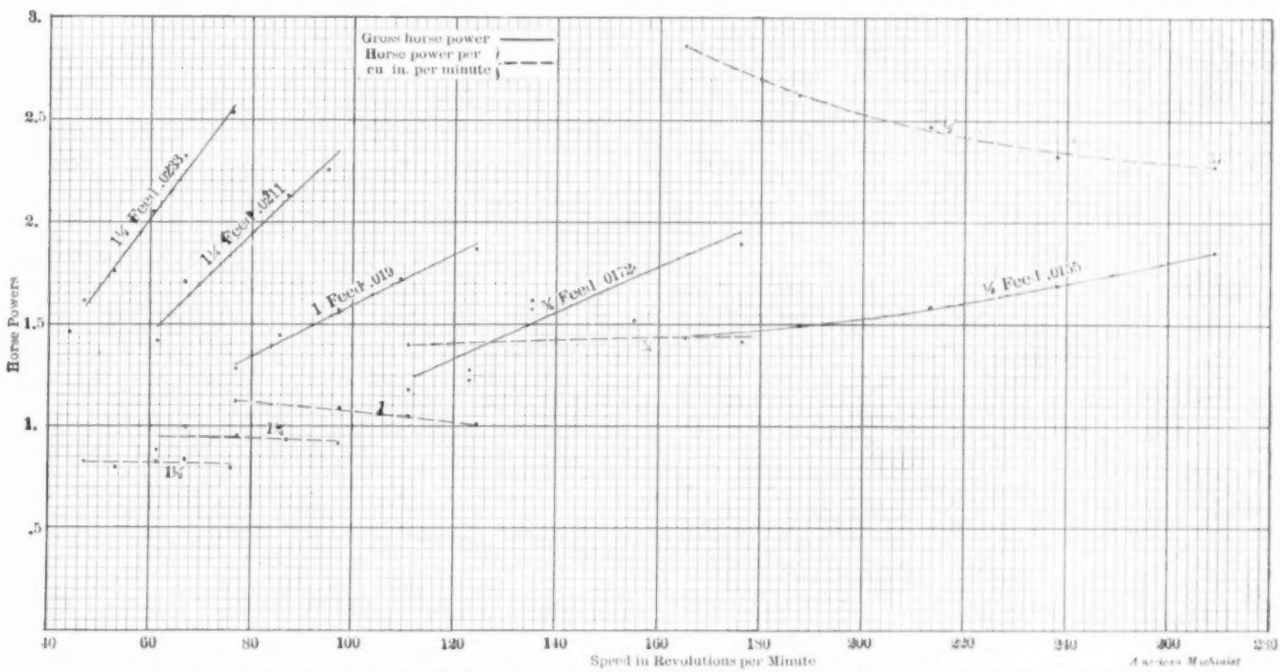


FIG. 2. RESULTS OF TESTS UNDER VARIABLE SPEEDS, THE FEED REMAINING CONSTANT FOR EACH SIZE DRILL.

Professor Higgins admits that a system of progressive and rapid instruction is desired in a school. This, however, cannot be realized by any workshop method, or even by a mixed method of combining teaching and manufacturing. For example, a class of thirty students with no knowledge of machine work is required to build an engine during a term of school, the castings and drawings for which are usually obtained from some manufacturer. At the end of the term, with the assistance of the instructors, the engine is completed. How much information and skill has each student acquired? One student is necessarily given a simple piece, another a more difficult piece; one bores and turns the flywheel, another builds the crosshead, another bores the cylinder, etc. Each, after unequal effort, has made a part of the engine and incidentally learned a few principles in an illogical and unsystematic manner, but no two students have had the same opportunities, and in general all must at best have only a superficial and tinkering idea of the subject. Is this the system of progressive and rapid instruction that Professor Higgins so earnestly desires? What would Professor Higgins think of a teacher who taught arithmetic to a class of thirty pupils who had no knowledge of the subject, by attempting to teach one addition, another percentage, another cube root, another mensuration, etc., during the same hour? To endeavor to teach the principles of the mechanic arts by building machinery or furniture is more irrational than this uneducational method of teaching arithmetic, and is an imposition on a student whose time is limited.

The Laboratory Method of Teaching the Mechanic Arts.—As every subject has its science as well as its art, a few schools teach the principles of the mechanic arts, which find their application in construction, not by building machinery or furniture, but first by the teaching of the science and then of the art, by lecture, demonstration and practice in well-equipped laboratories, precisely in the same manner as physics and chemistry are taught in laboratories. The laboratory method of teaching the mechanic arts is an organized method and just the opposite of the shop method of acquiring information and skill. The instructor presupposes a student's ignorance and begins at the foundation, thus developing the mechanical judgment of the student by making, in advance of practice, by lecture and demonstration, a careful study of such part of the science and its art as applies to the solution of the problem in hand. The study of any art is successful only when the first attempts are strictly subject to laws of systematic gradation, when every student adheres to a

definite method, surmounting difficulties little by little.

A method is worked out by graded lessons that demand the least length of time and which will provide a sound, systematic acquirement of information and skill, so that every step well taken is a clear gain and only successive steps have to be taken to reach success; a success that no shop system, mixed school and shop system, or any less systematic method can attain. Such a method is truthfully a laboratory method of progressive and rapid instruction. For example, it is desired to teach a class the principles of machine construction, such as chipping, filing, scraping, centering, squaring, turning, fitting, screw cutting, drilling, chucking, boring, planing, milling, grinding, and the mechanism of the tools and apparatus involved in the processes, in two-hour periods every second day during the school year. At the beginning of each period, the students assemble in a lecture room, thoroughly equipped with proper machines and tools, where all can hear the instructor, see the demonstration and method of solution of the problem. The students are then given drawings and material for the problem and proceed to the laboratory, where all have equal opportunities to practice and apply the instruction, not with a venture, but with a clear knowledge of the method of solution, thus obtaining results many times more effective than is possible by endeavoring to teach through the construction of machinery or furniture, where the instruction and opportunities for practice cannot possibly be uniform; the teaching results of the laboratory method are very large as compared with the manufacturing method. This method of presenting a subject to students awakens interest, creates enthusiasm, makes them think logically and plan intelligently, all of which gives the most practical and thorough training. The tremendous energy and earnestness awakened in a class of students when they realize how quickly they obtain good results and how rapidly they are advanced, are in themselves effective agents to make the laboratory method beyond comparison so successful and practical.

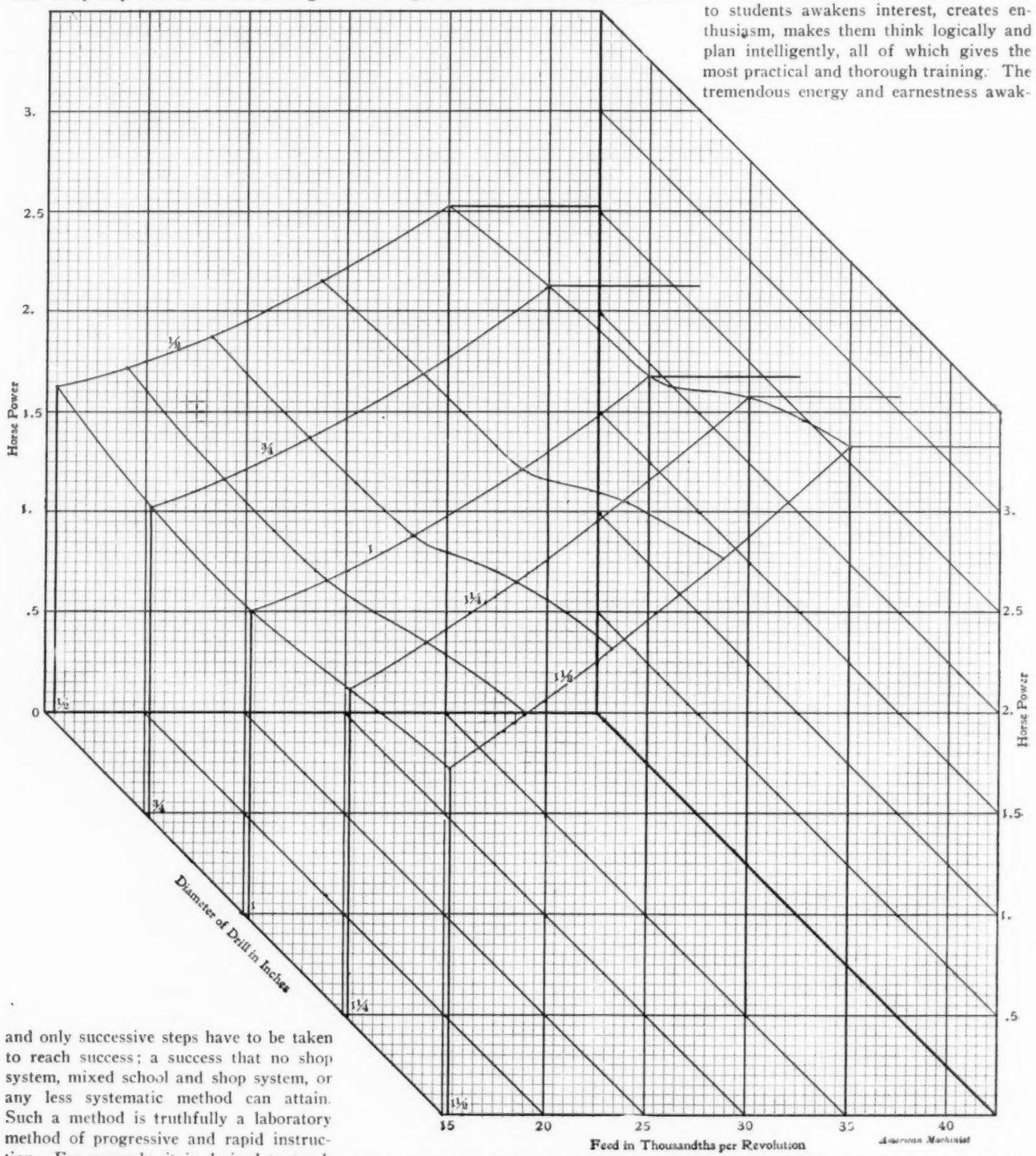


FIG. 3. RELATION OF DIAMETER, FEED AND GROSS HORSE-POWER AT A CONSTANT CIRCUMFERENTIAL SPEED OF 30 FEET PER MINUTE.

To call such departments of a school shops or workshops, when they are laboratories teaching the respective subjects as scientifically as any subject is taught in other technical laboratories, is certainly misleading. In many cases, young men coming to the institute from manual training schools and shops have had only a very superficial idea of the subjects to which they had devoted much time. They were usually unable to do the elementary problems such as are given to "Tech" students at the beginning of the course and such as must be known in order to do advanced work intelligently and with despatch. Upon investigation it was found that a large part of their time was spent in the shop in the reproduction of similar parts and in the school shop by building some machine or piece of furniture to be used principally for exhibition purposes,

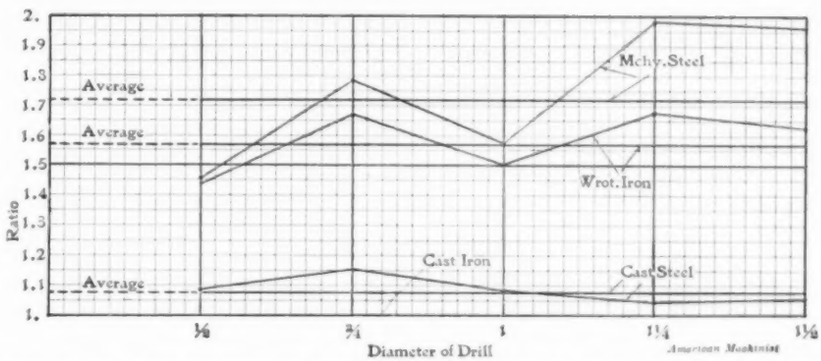


FIG. 5. HORSE-POWER REQUIRED TO DRILL DIFFERENT MATERIALS COMPARED WITH CAST IRON.

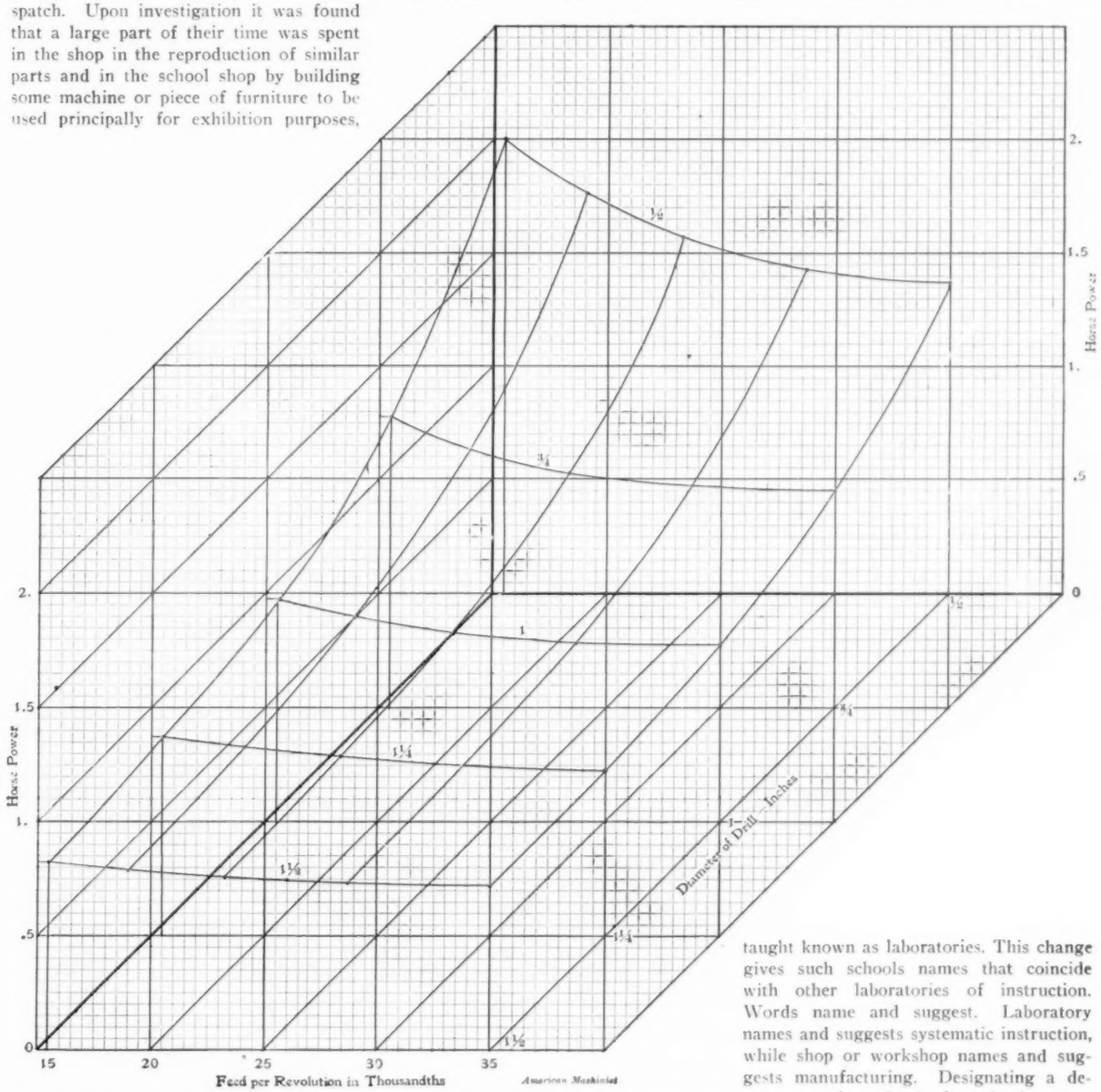


FIG. 4. RELATION OF DIAMETER, FEED AND HORSE-POWER PER CUBIC INCH REMOVED PER MINUTE AT A CONSTANT CIRCUMFERENTIAL SPEED OF 30 FEET PER MINUTE.

with but little, if any, systematic instruction and previous training in the elementary principles of the subject, and with a lack of variety. As the institute does not teach the principles of the mechanic arts by building machinery or furniture, but by the laboratory method, it was thought best to have the places where such arts are taught known as laboratories. This change gives such schools names that coincide with other laboratories of instruction. Words name and suggest. Laboratory names and suggests systematic instruction, while shop or workshop names and suggests manufacturing. Designating a department of a school of mechanic arts a workshop has undoubtedly influenced many efficient instructors to teach by building machines or furniture, rather than by educating the student by the organized laboratory method. The distinction between the school or laboratory and shop

should be clearly understood. Each has its own sphere, without trespassing on the other, the laboratory preparing for the shop and supplying what every shop foreman expects his young men to know before they are really useful to him.

By the laboratory method, the principles which underlie the arts and examples in their application may be taught far more economically and effectively than they can be taught in the real shop, so effectively that three or four hundred hours of instruction and practice by the laboratory method is equal if not superior to three or four years in a shop, and thus is secured the greatest economy of time, therefore of money.

The laboratory method, however, cannot teach experience. The shop and processes of manufacturing should supplement the laboratory. The large range of work in a modern shop presents opportunities for the application of principles, but it is in the laboratory that these principles are logically and rapidly acquired. The laboratory trained student not only must perform the work in the educational order, and that by the wisest and most modern methods, but he must know why he performs it and what it teaches; all of which gives him a most thorough understanding of the science of the subject, and this, in all branches of education is necessary to success in more advanced work.

In reply to Professor Higgins' statement that the laboratory is for "scientific experimentation and original investigation to find the unknown," allow me to say that the very essence of technical education, that system of education that has been the greatest factor in making America the foremost nation of the world, is laboratory instruction and practice in known laws. Professors of chemistry and physics, in teaching their respective subjects, tell their students plainly that the course is not for original investigation, but for scientific instruction and practice in known laws.

Research investigation and scientific experimentation are pursued in regular laboratories by professors and instructors in a private way, and occasionally by students for thesis or some other special object, with the supervision of their professors, but not until the students have been thoroughly taught the principles of the subject by lecture and laboratory practice. This practically coincides with the laboratory method of teaching the mechanic arts. Students are not allowed to build machines, furniture, or to do any constructive work until they have become thoroughly familiar by means of instruction and laboratory practice with the principles which are to be applied.

Laboratories for instruction and practice in known laws are as common in technical schools as lecture rooms in theological schools; in fact, so common that laboratories for purely research work and scientific experimentation are often qualified as Sanitary Research Laboratories, Physical-Chemical Research Laboratories, etc., in order to distinguish them from the regular laboratories.

Professor Higgins is unquestionably a true friend of mechanical and industrial education, and as such has our enthusiastic admiration, but he should realize that the world moves and that the acquirement of mechanical knowledge and skill by the slow, illogical and unsystematic methods of our forefathers will not do in this horseless and wireless age. These must give way to a more progressive, instructive and rapid system, such as that afforded by the opportunities in a well-equipped and well-managed laboratory.

Mass. Institute of Technology,
Boston, Mass.

Delayed Justice.

The ordnance factories have just sanctioned an annual expenditure of some hundreds of pounds to be distributed in rewards to arsenal employees for inventive suggestions with the view to improving or cheapening the manufacture of guns, projectiles, ammunition, gun carriages, small arms, and other warlike stores. An annual grant will be made in the Ordnance Factories Estimates to be laid before parliament, and the workmen employed in the government establishments at Sparkbrook, Enfield, Waltham Abbey, and Weedon will be allowed to participate in the rewards in addition to the 18,000 men employed in Woolwich Arsenal. Some of the most important inventions of modern times in connection with war have originated with government mechanics, but there has been a rule which has prevented their introduction into the united services otherwise than through a superior officer, and the original inventor has gone unrewarded.—*The Mechanical World.*

One of the features of the new plant of the B. F. Sturtevant Company at Hyde Park, Mass., is the steam tunnel 4½ feet in width and 6½ feet high, extending from the power plant to the most remote part of the manufacturing buildings, a total distance of about 800 feet. This tunnel, which is of concrete construction, will accommodate all of the steam piping, the electric wires for power, light, telephone, standard time clock, and other service, together with oil, hot-water and other pipes for general distribution to the various buildings of the plant. None of these features of the equipment will be carried above ground at any outdoor point.

It is estimated that 750,000 acres—over a thousand square miles—would be required to be continuously employed to maintain the supply of ties for the railroads of the United States. The steel tie seems now to be very close to its practical and extensive adoption and the condition of the steel trade seems to be peculiarly favorable for the development of this new and doubtless ultimately extensive industry.

A Microscope for Measuring Screw Threads.

We illustrate herewith, chiefly from information obtained from *Engineering* but partly from additional information from the makers, a microscope with special adjustments for measuring screw threads. The instrument has been made by the Cambridge Scientific Instrument Company, of Cambridge, England, for the Small Screw Gage Committee of the British Association, by whom it has been placed in the custody of the British National Physical Laboratory.

The normal capacity of the instrument is for measuring screws up to ¼ inch in diameter, though by means of special chucks screws up to ½ inch diameter can be measured.

The elements which can be directly measured for any given screw or tap are:

1. External diameter.
2. Diameter at root of thread.
3. Pitch; to which should be added, in the case of V-threads—
4. "Effective diameter"—that is, the mean diameter of the slant surface of the thread.
5. Inclination of side of V.

Moreover, the various inequalities to which screw threads are liable can be detected and estimated; for example, irregularity of pitch, variation of external diameter, and of depth of thread.

The instrument is well shown in the half-tones, Figs. 1, 2 and 3. The microscope tube is swiveled to permit its being set over to right or left, the amount of this inclination, which should be equal to the mean rake of the thread, being read by a graduated arc. The tube may also be turned upon its axis in order to adjust the cross wires to read the angles of the thread, as indicated in Fig. 4, the angle being read from a graduated circle at the base of the tube. The readings for diameters, pitches, etc., are obtained from micrometer screws attached to the stage. The arrangement of cross wires is shown in the line engravings, of which Figs. 5 and 6 show also one method of measuring the diameter of the screw or tap. The tops of the threads are brought by estimation midway between the parallel cross wires and the diameter is, of course, the difference of the micrometer readings corresponding to the two settings. The same measurement may also be made by turning the barrel through a right angle and using the single cross wire.

For measuring the angle of the thread and the pitch a provision is made to insure that the true profile at the extreme diameter is in focus. The outside diameter having been measured as indicated in Figs. 5 and 6, the instrument is then adjusted to bring the uppermost part of the thread in focus and, the tube being set over to the angle of mean rake, half the diameter multiplied by the secant of the angle gives the amount by which the instrument must be focussed

down to obtain a correct view of the profile.

The screw under observation is held in a self-centering split chuck, of which an assortment is shown in the half-tones, and which is carried on a cylindrical spindle supported in adjustable V's. By sliding the endwise movement a micrometer adjustment is provided for reading the pitch for which the adjustment of the cross wires is shown in Fig. 7, the intersection of two cross wires being made to coincide with the slant side of the thread. After making this adjustment the screw is traversed axially until the same intersection coincides with the corresponding slant side of the next thread when the difference of the two readings gives the pitch and, by extending this observation to different parts of the screw, any deviation from uniformity of pitch may be detected and measured. The measurement of the pitch may also obviously be made by adjusting the cross wires as in Fig. 4.

A weight will be seen to be provided for taking up all back-lash lengthwise of the spindle in the V's any desired part of the length of the screw can be brought under observation and by turning the spindle different parts of the circumference may be viewed. For the latter adjustment a graduated circle is provided. For the screw and maintaining constant thrust in one direction on the axial micrometer screw. In the inclined position of the instrument the weight of the carriage performs the same office for the movement perpendicular to the axis.

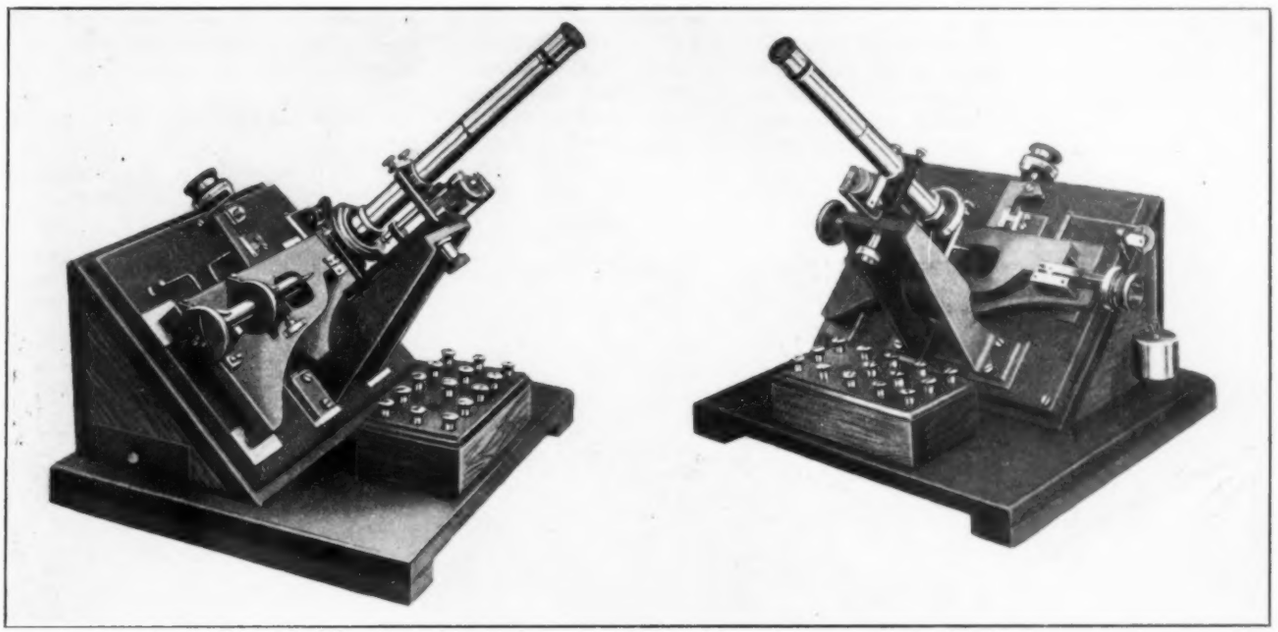


FIG. 1. SCREW MEASURING MICROSCOPE. FIG. 2.

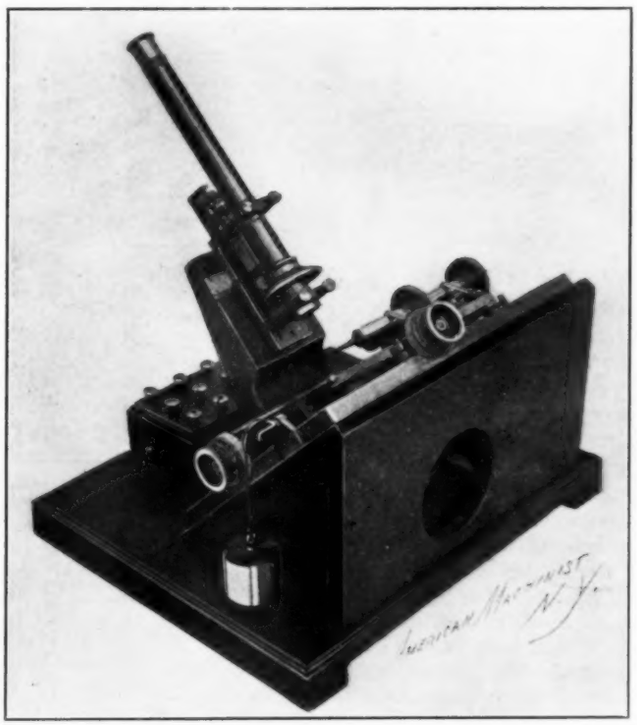


FIG. 3. SCREW MEASURING MICROSCOPE.

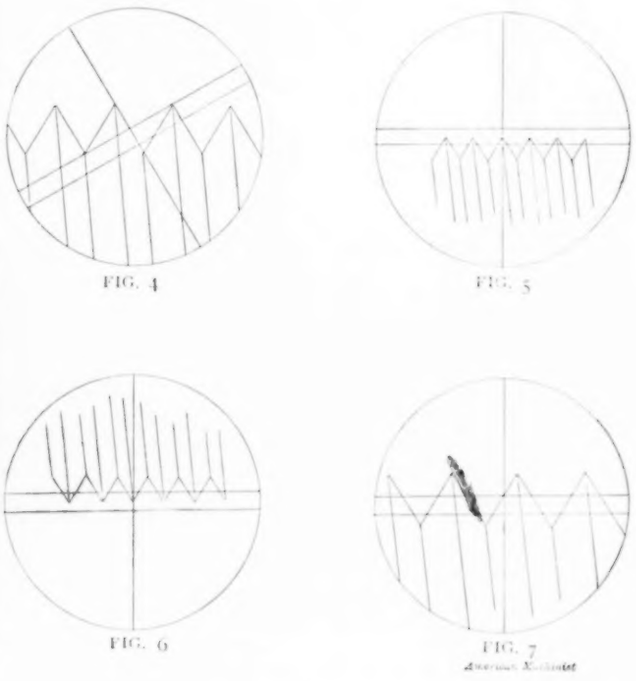


FIG. 4 FIG. 5

FIG. 6 FIG. 7

ARRANGEMENT OF CROSS WIRES AND VARIOUS ADJUSTMENTS.

The Filing of Drawings.

BY HENRY HESS.

This is a subject that might be classed with the hardy annuals of the gardener's catalog, as there is a new crop at least once a year and also one of endless variety. Many plans have been used and more suggested having in view the storage of the greatest number of drawings in the least space while leaving them readily accessible. The plan and furniture here shown do, I believe, combine these desiderata in a high degree, and also give opportunity for an indefinite expansion by mere aggregation of similar parts. Adaptability to any space available in the drawing room is also among the advantages. That the general appearance is neat Fig. 1 will bear witness, as no doubt the editor also will be pleased to do, having seen them while on one of his periodical European trips to the benefit of the home builder and foreign user of machine tools.

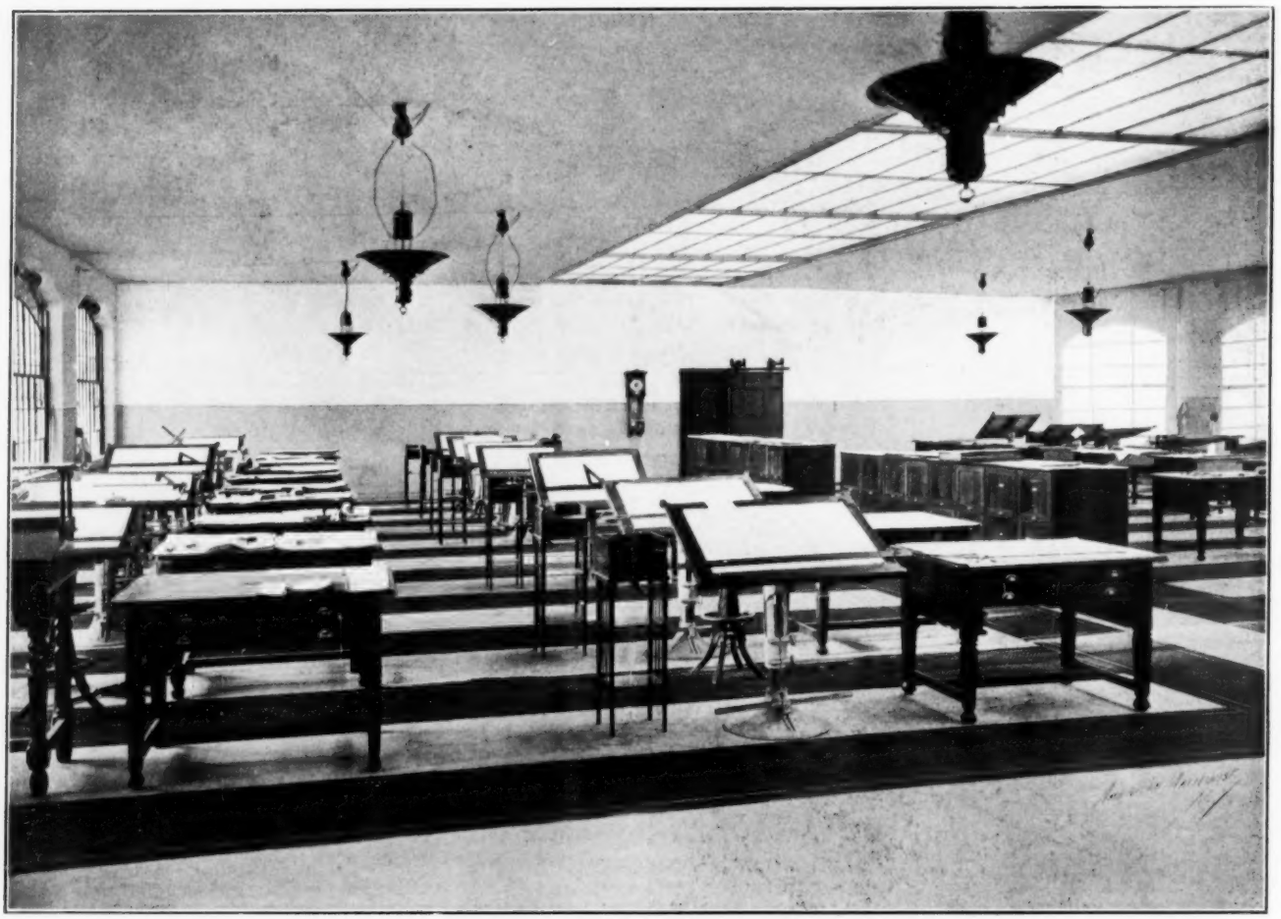


FIG. 1. A GERMAN DRAWING ROOM.

The cases for containing the drawings are built up of individual units along the general lines of the now so well and universally known "expanding" bookcases and office furniture, as sketched in Fig. 2. Each unit is a case 12 inches high by 39⅝ inches wide by 13 inches deep in the clear; a vertical partition divides this into two compartments each 19 inches wide; each of these is fitted with a drop leaf front shown closed in the upper and open in the lower part of Fig. 2. Each compartment is adapted to receive eight sliding trays shown in Fig. 3. These trays are made of 3-16 inch well-seasoned whitewood. A thin, narrow covering strip at the rear prevents the drawings from escaping at the back; the base extends beyond the sides to slide in grooves sawed in the side walls of the cases. As all drawings are numbered at the lower right-hand corner a ready fingering of the sheets is facilitated by cutting out the corner of the tray bottom. The cases are set on two drawer bases and finished as to the top by a flat cover. When placed two high the top forms a convenient consulting table.

The half-tone shows quite clearly the arrangement adopted for placing these cases. A series extends down the center of the drawing-room facing one side; back to back with this a second row faces the other side of the room. There are forty double units, twenty to a side, which take up a length of 35 feet, a depth of 30 inches and a hight, not counting the drawer bases, of 33 inches and accommodate readily 16,000 sheets, each 12x18 inches. Larger sheets of double this size are folded in two, while full-size sheets of 24x36 inches are folded in four. As regards the space occupied these are rated as two and four sheets. Twenty-five sheets are assigned to a tray and give a convenient subdivision and cause not the slightest crowding. In case of need a tray could hold twice the number, but at the expense of convenience of handling and the sacrifice of the ability to slip a sheet into its place without handling the entire trayful.

The location of any drawing is a simple matter, as there are label holders on the drop-leaf fronts and numbers on the trays corresponding to the system of numbering in use.

A few of the cases are fitted with shelves for the reception of bound sets of blueprints, drawing-room accounts, text-books and technical papers. Card-index trays also are comfortably housed, while the drawer bases serve for the convenient storage of cut sheets of paper and cloth, general stationery and supplies, and the various odds and ends that are continually accumulating.

In the modern industrial railway equipment, where turn-tables are used for outdoor work, there is always a temptation to set the turn-tables upon too shallow a foundation, the result being that they are thrown out of line by the influence of the frost. In the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., where special turn-tables of their own manufacture have been introduced in con-

nection with their industrial system, each turn-table rests at the top of a brick circular well with 8-inch walls extending to a depth of 4 feet or below the frost line. These walls are set upon hard-pan and the center filled with loose stones, providing perfect drainage. The first winter's experience has shown them to be absolutely uninjured by frost.

Grinding.

The interesting contributions upon the above which have lately appeared in the AMERICAN MACHINIST would seem to indicate a desire for some more practical information on a branch of trade practice of growing importance, and the recently expressed desire to be put in communication with an operator has induced me to pen the following.

In the first place, I partly agree with Mr. C. H. Norton, and think with him that it is impossible to give any general rule or data that would be universally applicable to the art. Conditions vary with the construction of machines, and what would be good practice on a light machine might in some respects be a failure on the heavier tool. Nevertheless, I cannot help thinking (speaking as an operator) that an explanation of a few simple rules that I have framed for my own guidance will be of some service to the uninitiated.

The compiling of tables and the keeping of records, which were mentioned by one correspondent, would, I think, be of service only individually or locally. The endless variety of shapes and the multiplicity of sizes, together with the varying construction of machines and the absence and impossibility of a standard for the many different makes of wheels, would be a drawback to its general utility. Every piece must be taken on its merits, and it would seem better to leave the matter to the judgment of operators, they being chosen for or according to the interest and intelligence they bring to bear on the subject. Without this it is quite possible to make the grinding machine a very expensive tool to use, and the "feed-and-speed-man" or his equivalent would be perhaps a desirability in a process where the cost of material employed may very often be lost sight of in the gratification and surprise at the results obtained.

I say this advisedly, because I have seen a pile of wheels, purchased with the best of intentions, which would be more serviceable if used as road metal than for the purpose for which they were manufactured and sold. In an experience covering about twelve years, both as operator and superintendent, I have had opportunities of handling many types of machines, both for plane and cylindrical surfaces, including Brown & Sharpe, Landis and two of German make, also the heavy machine that bears Mr. Norton's name, and though all have their good points and their bad ones, I may safely say that, from an economic point of view, the heavier the machine the better the results. By economy I am here referring to the amount of abrasive material required to remove a given amount of stock, and at the same time get satisfactory results in regard to finish and time. The extra amount of pig iron gives a rigidity which enables harder wheels to be used, and I may instance the No. 2 Brown & Sharpe universal and the No. 16 plane machine. In the first named I was never able to use a wheel harder than "L," while in the latter an "M" wheel gave satisfaction on similar material of proportionate size.

In the Norton machine I have used an "N" wheel, with satisfactory results. These comparisons are not made in any disparaging manner, as each machine is well adapted for the purpose for which it was designed and which is within its capacity; but it will serve to illustrate the fact that the heavier spindle and proportionate construction bear some relation to the texture of the wheel that may be used, irrespective of its size.

In my choice of wheels, coarse ones are always preferred and made of a combination of various numbers of grit, this union being essential for roughing and finishing with the same wheel.

I have learned by experience that a fine wheel is altogether unnecessary for a high finish. This may seem a rather contradictory statement, but by careful truing of the wheel and by exercising judgment in the finishing process, a finish as good or better can be obtained with a coarse as with a fine wheel. I don't pretend to be able to explain this, but I should imagine that the kernels of grit in the fine wheel being so small they have not enough tenacity to resist the diamond, but are torn bodily out, leaving behind them a surface composed of innumerable sharp points. In the coarser wheel the tenacity of the grit is greater, and the diamond rather turns than displaces them, leaving a surface of irregular shaped pieces, the shearing action of those with the broader face removing the minute projections in the work and acting as a former for the finer pointed kernels. A close examination with the microscope of the relative wheels and finishes obtained seems somewhat to be a proof of this; the surface finished with the fine wheel being composed of fine, deep scratches with some regularity of pitch and form, while the surface from the coarser wheel shows inappreciable indentations of varying shape and size.

My knowledge of metallurgy is not sufficient to enable me to choose a wheel for a job to correspond with the amount of carbon contained in the material, nor are drawings always explicit on this point; but being at present engaged in the operation of the heavier machine (to which the late correspondence in the paper mostly refers) the moment seems the more opportune for explaining my method of procedure.

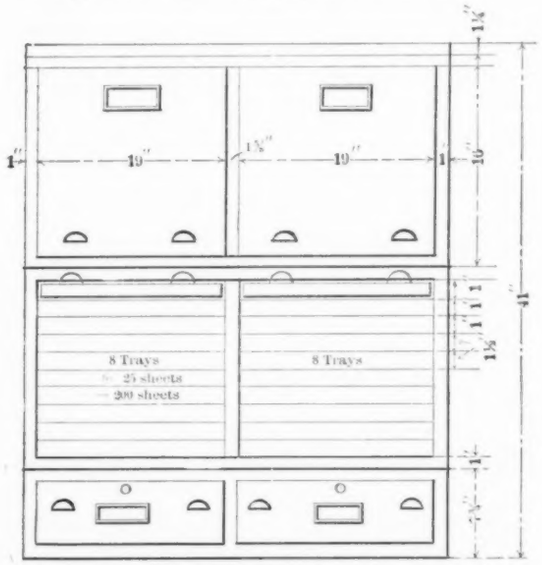


FIG. 2. FILE CASE FOR DRAWINGS.

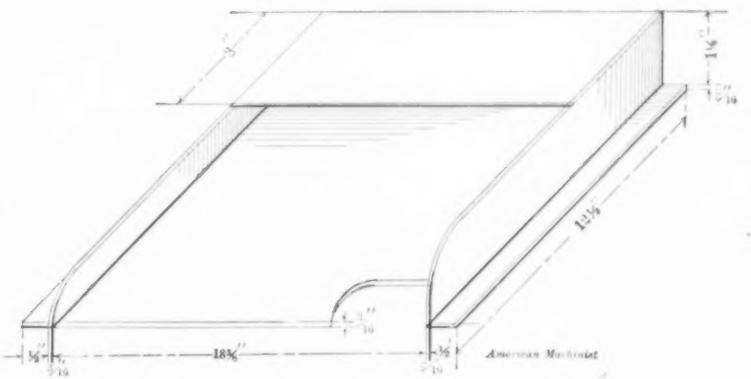


FIG. 3. TRAY FOR DRAWINGS.

I have six wheels, *J, K, L, M, N* and one soft-elastic. They are all vitrified except the last one, which insures a uniformity of grade and cool cutting. For the benefit of the novice, I may say that the letters denote the progressive degrees of hardness, and are those of a maker who can always duplicate them.

If I grind very soft steel, I use *N* as a rule, but *M* if it is a long slim piece. For ordinary machine steel I use *M* for stiff pieces and *L* for slender ones; for tool and other high-carbon steels, *L* or *K;* for case-hardened work or hard steel, *K* or *J*, and the same for cast iron unless a very high finish is required. When this is the case I use the elastic; this wheel is also good for chilled work. Brass or copper I have little experience of, and I don't know a suitable wheel, though no doubt an elastic one would answer the purpose. I would welcome some information on this, and also as to wheels suitable for paper and cotton rolls.

With regard to the question of work speed and the feed or side advance of the wheel, I had never until lately given the first particular much attention, but, from records taken lately, I rough out at about 35 feet per minute, and the finish required decides the speed I shall run for the final cut. After roughing out, if I true the wheel up nicely, I can get a passably good finish at the same speed, but the quality of finish is generally in the same ratio as the number of turns of the piece, and this may reach 5 feet per minute. This slow speed, however, is necessary only for pieces whose peculiar shapes make them likely to chatter, decreasing the number of rotations reducing vibration. In ordinary pieces, when once the desired finish is attained, it is safe and often necessary to increase the speed to remove feed lines without spoiling the finish, though the cut must be infinitesimal.

In roughing I am always governed by the results of a few seconds devoted to experimenting on the combination best suited to the wear of the wheel. For example: A piece is being ground at a certain number of turns, with the automatic cross-feed set to remove .010 inch and table feed at 3 feet per minute. When cutting ceases the work is measured and the reduction is found to be .009 inch and the wear of the wheel has been .001 inch. I rotate the work faster, and this of course enables faster table feed. Should the wear of the wheel be increased, it then becomes a question of judgment as to whether the saving in time will pay for the extra cutting material consumed. If the wheel shows no increased wear, the experiment may be continued until you reach a combination of feed and speed that will give the greatest efficiency.

To go back a little, I mentioned two wheels that were suitable for soft steel or common machinery steel; if I should get a piece to grind that I have had no previous experience of, I should use the harder wheel *M*, and if too hard, I should change it for the softer one. If I found after trying various speeds, that the wheel required unreasonable pressure to enable it to cut, or that it would constantly chatter, or that the heat it generated through undue friction was such that the work changed color or burnt when a liberal supply of water was provided, it would be a proof to me that the wheel was too hard. For long, slender pieces the softer of the two wheels is always preferable. The flexibility of the piece is such that the harder wheel may displace it, and if it should burn it at any point it means suspending operations to straighten it unless there is enough stock left to true up.

In grinding long, slim pieces, it is always found necessary to spring them up by the steadies till they form an arc, the hight above the center in the middle of the piece being in proportion to its flexibility. This tension is necessary to reduce the vibration due to the rubbing of the wheel. For this purpose the steady rests or supports must be made capable of both vertical and horizontal movement. Speaking of steady rests, the fixed rest is always preferable where heavy reductions are made. For a light class of work I have found them the best in the smaller type of machine; but, a spring being an uncertain quantity, they are unsuitable when deep cuts and broad wheel face are combined.

In all roughing I find it is the best thing to rough out accurately, and to get the piece as near to a uniform diameter as if you were finishing. It saves much time in the latter operation, as the sparking of the wheel will be a guide to the uniform chips that are required, and it is better to do this than to have to tax the memory as to the exact spots where the piece was a little above size. In finishing cast iron I find that the fewer cuts I have to take the better, as chatter marks are liable to appear if the operation is prolonged. When these appear I find it the quickest way to true up the wheel again. In grinding any cast-iron piece, the best combination should be searched for in regard to the wear of the wheel, the necessity for using the softer grade of wheel leading to much waste if a little care is not exercised. Chatter marks are liable to make their appearance from a variety of causes. If caused by an untrue wheel, they will assume a helical form. They may be caused by a too hard wheel, or by a wheel glazing through taking very light chips. In this case more rapid rotation of the work will sometimes cure it, the increased speed roughing the wheel a little and lessening the vibration. Inefficient or insufficient steadies of course suggest their own remedy, but in all roughing operations the chatters may appear through the heavy cut. I ignore them entirely unless they get very bad, taking precautions in finishing to avoid them.

The relation of table feed to rotation of work is of little account, though I always take the first few chips at the roughing speed and the highest possible feed, slowing the feed down for the final chip. By this means I keep the face of the wheel flat and lessen the danger of feed lines appearing in the finished piece. By the fastest possible feed I mean the side advance of the wheel to equal its bare width of face per rotation of work, and in machines that I have handled where this was not practicable I have got as near to it as their mechanism would allow by changing the feed pulleys. In roughing the piece I have instanced it should have been mentioned that the feed should be arranged in this manner on commencing operations, increasing it as the speed was raised.

The incident mentioned of the operator who made the large reduction in time on a certain piece of work may possibly have been due to a more matured experience, and is no more extraordinary with a grinding machine than with any other tool. There is no magic or mystery about it, and a little experience and ordinary application can set things going in a profitable manner. Besides the few combinations I have mentioned, and which I earnestly hope will be understood by those interested, the principal things required are good wheels which can be easily duplicated and a plentiful supply of water to control the temperature and for hygienic reasons. This latter cannot be too much insisted on, both as regards operators and designers of machines.

In internal grinding water should be used wherever it is possible, and its utility will be shown in the results obtained. I use it constantly for this purpose, and would do the same in surface grinding if machines would lend themselves to its application. Wherever I have had an opportunity to apply it, the output has been considerably increased, and a disagreeable job has been transformed into a pleasant one.

Speaking of surface grinding, this branch of the art seems to be sadly neglected. Nearly all the matter published is in reference to the cylindrical machine, and is mostly devoted to heavy grinding and the rapid removal of stock, tending to convert the lathe into a roughing tool only. The satisfactory improvements that have been made in abrasive materials and the success of high-speed cutting steels should also be a means of developing the surface grinding machine in conjunction with the miller and planer. The general impression seems to be that true plane surfaces can be produced only by hand scraping, and this to some extent is true; but a surface that has been carefully planed bears the same relation to one that has been carefully turned, in the matter of time employed, and most always contains errors due to unavoidable causes, that must be corrected by hand. My experience has been that the more accurate and quicker way is to grind them. In a machine for this service, if all its alinements are kept

in satisfactory condition, the work that comes from it will be a copy of the same, and the old argument that a ground surface is next to impossible to scrape is just as much a fallacy as the mistaken idea that the emery adheres to the surface. Where suitable wheels are used this is not the case, and as the errors due to springing, etc., have already been corrected, the only scraping required is what is necessary to assist lubrication and the necessity for using the proof staff or surface plate is reduced to one or two applications. The only machines that I have handled for this class of work have been of the planer type (with similar movements, that is), and I don't know of any improvement that could be made for the purpose for which they were arranged, unless it might be the addition of a water supply. Even without this latter the system paid, although its absence meant very much personal discomfort from the dust arising, in addition to a much smaller output and a heavy bill for cost of repairs to itself and to surrounding machinery. It would seem that in this direction there is much room for improvement and a good opportunity for development. I don't know of any correct machine on the market, and a want of knowledge of machine design prevents me from giving graphic description to what my ideas are of the principal requirements. My experience of the cylindrical grinding machine has been that weight and stiffness of build, along with great range of work speed and table feed, also means for quickly changing them, are very essential. In the surface machine the conditions differ slightly, and the fact of the work being wedged between the wheel and table does not warrant much variation in the speed at which it travels, as the question of vibration need scarcely be considered. Weight and stiffness would seem as desirable, and an unlimited water supply is indispensable.

The wheel being hung over the work, a belt drive is unsuitable, the varying tension of the belt causing apparent chatter marks to appear on the work, especially if the belt runs vertically. A motor drive would seem to be the ideal thing, and should be quite safe if the water supply is sufficient to keep the dust down.

From an experiment personally conducted in this direction the amount of stock removed in ten minutes was three times the quantity that had been removed by the dry wheel, and the impression left was that with a more liberal water supply the result would have been better still. I may say that the water supply had to be limited to prevent the table overflowing.

The possibilities of the grinding machine seem infinite, and those who are not giving close attention to its recent developments are likely to be left behind; in very many cases the lathe is superseded, and in some is unnecessary. By the use of modern powerful machines results may be obtained that should convince the most skeptical. The often quoted idea that the cost of the cutting material is an offset to the increased production and superior work is entirely erroneous. Abrasive materials are constantly being improved, and the manufacture of artificial material superior for the purpose to the natural mineral products promises much for the future.

In conclusion, I again wish to emphasize the fact that there is nothing mysterious or more difficult to understand in grinding than in any other mechanical process. Perhaps the only thing it is suffering from is neglect; and it is quite possible that if there were more users of machines and more brains at work in connection with grinding, the progress made would be greater. As it stands at present, it must be a profitable investment to whoever takes it up. As one who had imagined some of the possibilities of the heavy grinding machine, its capabilities are a revelation to me, and if space would permit I could quote instances within my short, late experience of it, which would satisfy anyone of the reduction in cost of manufacturing and the superiority in quality of product as compared with the lathe or the lathe and light grinding machine.

In machining straight pieces the lathe is unnecessary. The rapidity with which stock can be removed is nothing short of marvelous, and the absence of the necessity for transferring work from the lathe to the grinder, with other incidental expense, would alone more than cover the cost of the grinding wheels. Eight feet of 2-inch shafting can be reduced 1-32 inch with a high finish and straight within an error of .0005 inch in something under thirty minutes, while another fifteen minutes would be sufficient to make double the reduction of stock. It is a rarity to meet with a rough bar that is round and straight enough to clean up at 1-32 over size, but most inventions are the outcome of necessity, and no doubt the rolling of steel bars and other processes previous to the machining of detail parts will advance at the same rate as the grinding machine, with a saving in material and in time.

R——, England. OPERATOR.

The Washburn shops, Worcester Polytechnic Institute, Worcester, Mass., are arranging a very complete catalog file for reference to be used by the students and instructors in mechanical engineering as well as for the commercial purposes of the shops. Each catalog is indexed under the manufacturer's name and its contents cross-indexed according to the various subjects treated. They request catalogs of manufacturers.

The editor of a technical journal—not our own—recently wrote as a caption for an article in the paper "Proper Angles for Tools," and it is said that his writing was so illegible that the compositor made it "Proper Angels for Fools."

Letters From Practical Men.

Making Piston Rings for Gas Engines.

Editor American Machinist:

In a small shop where I once worked we made gas engines in small lots from 2 to 15 horse-power. The pistons were of the usual type, as in Fig. 1. We found from sad and costly experience that it was necessary to make the diameter of the rear end of the pistons considerably

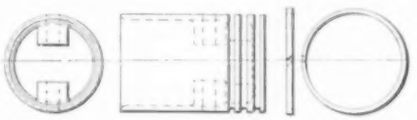


FIG. 1. FIG. 2.

GAS ENGINE PISTON AND PACKING RING.

smaller than the bore of the cylinder to allow for expansion. The rings were first made of uniform thickness all around, but never gave satisfaction. They were then tapered as in Fig. 2. This was first done with a file, but it was a long, tedious job and hard to get a good fit; so it was decided to do this work in a lathe.

The rings were cut from a casting bolted to the face-plate, bored and turned outside to a diameter a certain amount larger than the bore of the cylinder. The rings were cut off this casting from the inside by a tool to which a gage was attached for thickness. A piece was then cut out of each ring by two slitting saws mounted on the arbor of a light milling machine. The distance between these saws was varied for the different sizes by different collars between them.

A chuck shown in Fig. 3 was made for

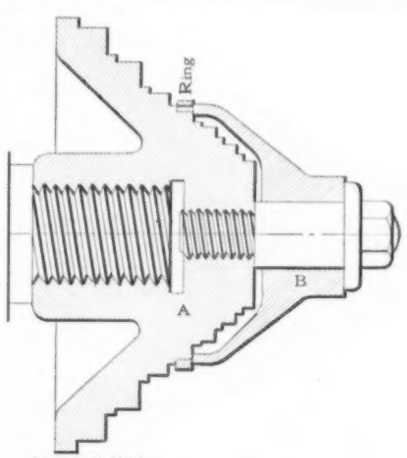


FIG. 3. CHUCK FOR TURNING PACKING RINGS.

sizing the outsides. It consisted of a casting with a series of steps and it screwed on the spindle of a 16-inch lathe in place of the regular face-plate. A cup-shaped casting *B* slipped over a stud and was drawn up against the ring by a washer and nut. Of course there were as many of these cups as there were sizes of rings. It was not necessary to remove the cup to put on a ring. A fraction of a turn of the nut was enough to free everything and

then the rings were easily sprung over. The steps were turned to diameters equal to the bores of the cylinders less twice the thickness of the rings in the thickest place.

Floor ____ 190__

FACTORY COST REPORT.

Order No. ____ Name ____

FOR ____

WORKMAN.	OPERATION.	Time or Count.	Rate of P.W. Price		
STOCK AND REMARKS.					

American Machinist

FIG. 1.

The rings were placed in this fixture sprung together by a wire band, and were held eccentric by the cup-shaped casting with the split part of the ring on the high side and the opposite side of the ring touching the step. The rings were now turned the exact diameter of the bore of the cylinder. This just cleaned up the thick side of the rings, but turned them quite thin where they were split. They were now ready to go into the cylinder and gave no more trouble. The amount of time saved over that spent in making our first rings was something astonishing.

H. A. HOUGHTON.

Estimating Costs of Sheet Metal Goods.

Editor American Machinist:

Numerous and peculiar are a great many of the articles that are submitted to us to make of various sheet metals, some parties furnishing a crude sample made by hand, and others merely a memorandum or sketch of the article desired. The system to which these new articles are subjected in estimating the cost is as follows:

In every instance the invariable question of the inquirer is the cost to him for a quantity usually stated in his letter, together with the cost of the necessary tools. The sketch or the article, if a sample is furnished, is sent with the letter to the foreman of the department that would make the article, and after ascertaining the various operations and tools required, he fills out a Factory Cost Ticket, Fig. 1, with all the information regarding the operation and the estimated cost of each operation, the stock required and the necessary tools, and then sends the ticket with the letter, etc., to the party in the office who has the matter in charge. If more than one department should handle the article, the letter, after being endorsed by the foreman, is sent on by him to the foreman of the next department that is to handle the work, the factory cost ticket only being sent to the office. All foremen of departments that would handle the article do the same, returning their cost tickets to the office and passing the letter and article to the next department, and so on until the letter and article are finally returned to the office by the foreman of the last department. On the return of all the cost tickets with letter, etc., to the office, the tickets are immediately marked "Original" and the man in charge sends the sample or sketch to the foreman of the toolroom with a memorandum of the tools and dies required for the job, who, in turn, this article a machine shop order, Fig. 3, containing a list of the tools required is issued to the toolroom foreman, who im-

MACHINE SHOP ESTIMATE. ____ 190

On Tools for making ____ *for* ____

TOOLS.	TIME. Hours.		STEEL. Lbs.		CAST IRON. Lbs.		FORGINGS. Lbs.	

American Machinist

FIG. 2.

MACHINE SHOP ORDER.

Order No. ____ *Job No.* ____

____ 190

Finished ____ 190

For ____ *Charged* ____ 190

Mark

V

Charge, $ ____

☞ This order must be returned to office IMMEDIATELY on completion of same, giving date finished.

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FIG. 3.

fills out the blank shown in Fig. 2, giving all particulars regarding the estimated weight and stock required and the time to make the tools, and sends the estimate to the office

These cost tickets and the machine-shop estimate form the basis on which the party in the office makes up his estimates of the cost of manufacturing the article and the cost of making the tools required. It is then his duty to communicate with the inquirer, when the ticket and machine-shop estimates are filed away until such time as the prospective customer sends on the order.

Upon receipt of an order to make up

MACHINE SHOP COST TICKET.

Order No. ____ For ____ Article ____

Commenced ____ 190 ____ Finished ____ 190 ____

WORKMAN	DATE	HOURS	STEEL	WROUGHT IRON	CAST IRON	FORGINGS	

American Machinist

FIG. 4.

mediately takes the necessary steps to make them. The regular factory order is meanwhile issued to the departments that have estimated on the article. Upon the completion of the tools required and called for on the order, a machine shop cost ticket, Fig. 4, is filled out by the foreman of the toolroom, giving the actual weights of stock used and the time required to make the tools, and is sent with the order, Fig. 3, to the office and compared with the original estimate, Fig. 2. The tools as finished are sent to the departments ordering them, receipts being given by the foreman, which receipts are appended to the machine shop order. All these records are then filed away.

Each foreman of a department, on the completion of his connection with an order, immediately issues a new factory cost ticket which contains the actual cost of the article and sends it to the office. These tickets are compared with the original cost tickets, and are used as a basis for other orders.

The object of the duplicate cost tickets is to overcome, whenever practicable, the loss due to underestimating on the article, and the making up of successive orders on the original cost ticket, which, while it answered the purpose for the first order, may be below the actual cost to manufacture. The system of having each department foreman estimate on his particular work in connection with each new article, eliminates to a large extent, the difficulties of the man in the office who has the estimating in hand, and it furnishes him with a practical and almost complete record with full particulars of each and every new job, so that it enables him to furnish an estimate of actual cost to inquirers.

A. C. R.

Internal Milling Attachment.

Editor American Machinist:

At page 1804, Vol. 26, W. H., of Birmingham, England, describes an internal milling fixture; and I will submit a drawing of one which I made some few years ago and which I think is an improvement on his design, as he depends, in his construction, on a belt drive which necessarily must be small and not positive. The fixture shown was used for cutting helical oil channels in large generator bearings, both right- and left-hand channels being required in each bearing. The attachment was made of a length sufficient to reach through our longest bearing, and a train of gears of 1 inch pitch diameter and 20 pitch, connected the cutter spindle to the driver spindle, which had a pulley for a belt of sufficient width to drive it properly. As we were cutting these oil channels in brass with a round-end cutter and the speed must be high, we used a motor to drive the fixture and got excellent and rapid results.

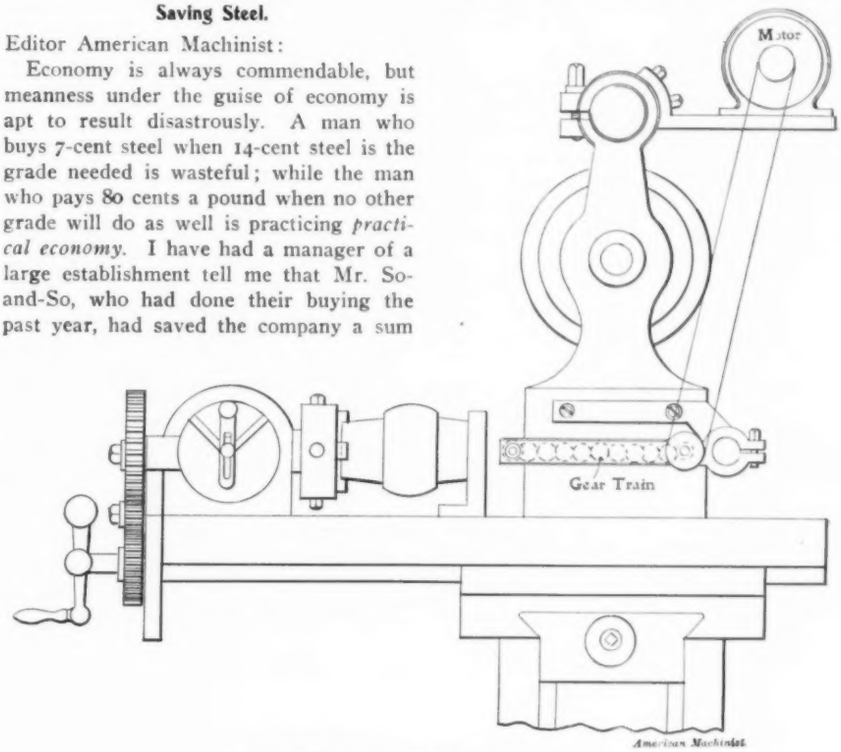
The sketch will show the method of attaching and operating the arrangement. If this device were to be used for gear or ratchet cutting, one would not need the high speed and could drive direct from the main spindle.

F. C. Mason.

Saving Steel.

Editor American Machinist:

Economy is always commendable, but meanness under the guise of economy is apt to result disastrously. A man who buys 7-cent steel when 14-cent steel is the grade needed is wasteful; while the man who pays 80 cents a pound when no other grade will do as well is practicing *practical economy*. I have had a manager of a large establishment tell me that Mr. So-and-So, who had done their buying the past year, had saved the company a sum larger than his salary on the steel account alone. The foreman of the machine department said that it had cost the company $1,500 more for tools used in that department than it had the previous year, to do the same amount of work, as the steel used had been inferior, to say nothing of the annoyance and delay.



INTERNAL MILLING ATTACHMENT.

When costly steel is used it is at times advisable to save expense by making the cutting portion of the tool of the required grade and the balance of cast iron or machine steel. Where tools are used in the same tool-post a permanent holder may be made, as in Fig. 1, and the tools may be fastened into it with a screw as shown.

At other times holders are made of soft steel, and the cutting portions of tool steel are soldered on. When this cutting part is of no further use, it may be removed and another cutter may be soldered in its place. This is not only a means of saving, but it is claimed by some persons that the layer of solder acts as a cushion and kills vibration, thus making a smoother cut than with a solid tool. I cannot answer as to the correctness of this theory; but I have seen some very nice surfaces produced by tools built up in this manner. I have used tools having blades inserted in slots in the holders, the tools held in place by soldering, and they worked very nicely.

A method I have seen used in some shops where "high speed" steel was used extensively consisted in brazing a piece of the steel on to a shank of stiff machinery steel, as in Fig. 2, the piece of high-speed steel projecting far enough beyond the end of the shank to allow of its being heated on the end to the extreme high heat necessary when hardening. To heat the end to the desired heat without affecting the brazing, the end is dipped in a crucible of lead heated to what is familiarly known as a "dazzling white" and then it is cooled in an air blast or in oil. If there are projections on the cutter, or if it is of a shape that makes it weak, it is advisable to reheat the cutter somewhat.

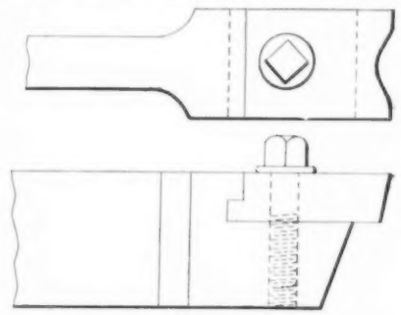


FIG. 1

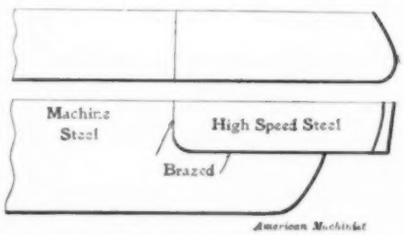


FIG. 2. USE OF COSTLY TOOL STEEL.

drawing it to a straw color; for while many people suppose this steel not capable of tempering, yet it is made much tougher if the temper is drawn somewhat. Of course when making tools that are strong it is advisable to leave them as hard as possible.

Milling machine cutters are often made with inserted teeth, and if high-speed steel is used the cutters can be run faster than if made of ordinary tool steel, hardened. When making cutters having inserted teeth, the body is made of machinery steel or cast iron, the former for small cutters, cast iron for the large ones.

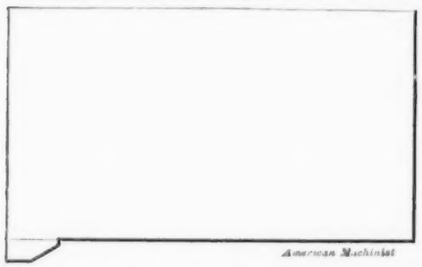
It has been ascertained by experiment that for a great variety of work where high speeds and coarse feeds were used, the modern high-speed steel at 80 cents per pound was cheaper than any other grade of steel would be as a gift.

E. R. MARKHAM.

Increasing the Capacity of the Drawing Board.

Editor American Machinist:

Every user of a T-square and drawing-board knows how difficult it is to keep the square right when working at the bottom edge of the board. Most draftsmen are so used to this difficulty that they unconsciously taboo at least 3 inches of the



INCREASING THE CAPACITY OF THE DRAWING BOARD.

board, which practice causes them to lean farther over the board than if they used the paper right to the lower edges. A small piece of wood, 3x4 inches, fixed to the bottom left-hand corner of the board will serve to steady the square when working there. The sketch shows the idea, which will increase the capacity of the board, and, by allowing small drawings to be made near the worker, will prevent much discomfort and indigestion caused by leaning too far over the board.

Birmingham, England. R. D. S.

Vertical Photography.

Editor American Machinist:

Having occasion to photograph a group of small machine parts, I was about to fasten them up against the wall when I caught sight of an unused drawing table, the top of which could be tilted at any angle. Resting the camera against the raised edge at the front of the board, I passed two straps around the bed of the camera, thus fastening it to the table top, and pointed the lens directly downward toward the floor on which I arranged the subjects. This proved to be an excellent arrangement, as the stand could be raised or lowered to bring the image the right size, the top could be tipped to get the perspective effect desired and the camera could be moved around until the best lighting was found. W. H. S.

Sympathy for Tools.

Editor American Machinist:

I believe that a machinist should try to get all that can legitimately be gotten out of any tool, but when I see men abuse tools of all kinds without turning out any more work than others, I believe there's something wrong. Men who'll use a lathe carriage or a planer platen for an anvil, tap a file on the ways of a lathe to clean it, use a hammer on a face-plate to loosen it, may in some exceptional cases turn out more work than others; but do they, as a rule? I don't believe it. A man who will willingly hurt any tool has usually not much "feeling" for his work either, and his disposition will be reflected in what he turns out.

Some work or tools need no sympathy and the harder we get at them the better for output. Most of the tools used in *our* work, however, are of a kind whose life of usefulness can be much lengthened or shortened according to the treatment they receive. If any tool is properly designed and well built, both feed and speed may be increased until the belt slips without hurting it in the least; but an accumulation of dogs, lathe tools, bolts and clamps on the ways of a lathe does it no good and *saves no time*. To the contrary, their presence there is indicative of a slothfulness that is not conducive to the greatest output of *good* work. It more nearly presents an unwritten demonstration of "No place for anything and everything in *that* place." When we get a man in from another shop, it usually takes some time to pound our unwritten rule into him to put "nothing heavier than calipers nor harder than babbitt" on the lathe ways.

Some men, and they are only too rare, have enough feeling for machines to respect their rights without being forced to.

VERTICAL PHOTOGRAPHY.

Men of that stamp will frequently clean and oil the cross-slide (while the machine is working) and some will even go so far as to clean and oil the lead-screw; but, alas! they are few and far between. The lead-screw, on the accuracy of which so much depends, and the cross-feed slide are, I believe, the most neglected of all.

A sympathy for tools cannot easily be inculcated into all men. By strict surveillance we can sometimes get the same effect, but it is only artificial. We all know men who'll harden a tool, walk to the nearest vise and pick up *any* file and rub it over the point of the tool "to see if it's hard." If they looked at the file they'd surely *see* it. Now there's a spot on every file, near the heel, that's never used, and there's where tools should be tried for hardness. It would take no more time than to ruin the file, as is frequently done.

I don't believe much more needs be said; enough has been given to enable you readers to know what kind of a fellow I'm trying to pick a quarrel with, only I want to do it without seeming to be an extremist. There are certain tools I have no sympathy for. Among them is the tool-post wrench. It's cheap and need not be accurate, and to tap the back end of a tool with it to get the right angle I consider no sin. Wrenches are cheap and time is money. CORNELL RIDDERHOF.

Cutting Left-Hand Threads—An Ancient Donkey Wheel.

Editor American Machinist:

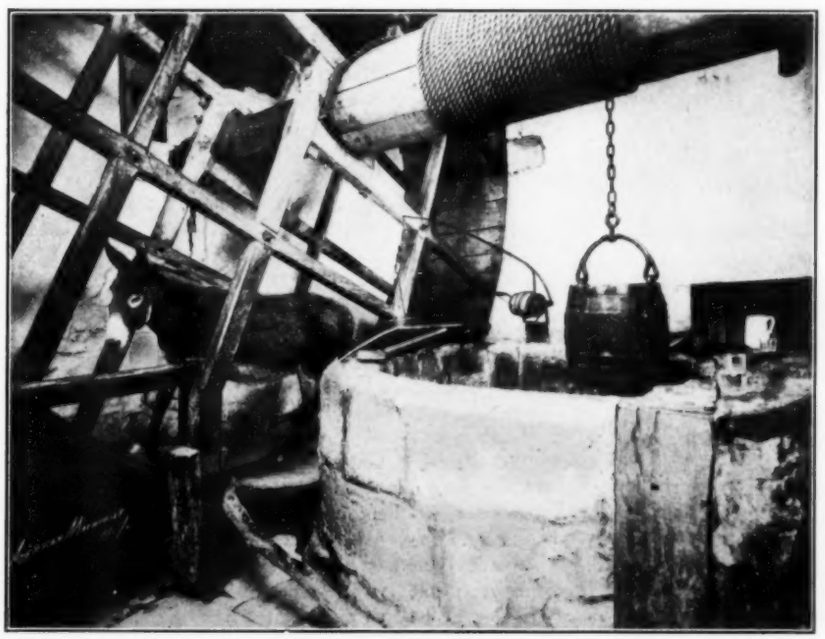
J. E. Wilson's article at page 1439, Vol. 26, concerning left-hand thread cutting and the one by D. W. R. at page 1527, on the same subject, interest me, and I would like to add that I have known one very expert lathe hand who expressed himself as believing left-hand threads easier cut than right-hand threads, which implies they may be cut in less time. The statement that more time is necessary in the cutting of left-hand threads, while not wholly novel, seems true only for the reason given by D. W. R., viz., our unfamiliarity with them. If I may be allowed to cite the result of my own experience it would be a decided preference for left-hand threads. Believing that this statement will call for reasons, your attention is called to the absence of a shoulder or a too narrow clearance groove at the termination of your cut in cutting left hand. If it be said that your cut is begun in the solid metal it may be pointed out that as wide a clearance groove is available for beginning the left-hand cut as for terminating the right-hand, and that with no clearance groove it is always an easy matter to gradually *begin* a cut in the solid, as the beginning end of your left-hand screw may usually taper larger without detriment to the screw. A clearance groove is not at all necessary.

. . . . . .

I send you something as unrelated to the above as could well be imagined. It is a photograph of the Carisbrooke Castle well and donkey wheel. The well was sunk by Baldwin de Redvers some 800 to 900 years ago, and is 240 feet deep. While it is not claimed that the same individual donkey has drawn its water all of these years, the claim is made that the duty of drawing water from this famous well descends from father to son, and is never shared outside this one royal family of donkeys. On the farther side of the well may be seen a small hand windlass used to lower a lighted candle into the well that visitors may see its depth.

WM. S. ROWELL.

Manchester, England.

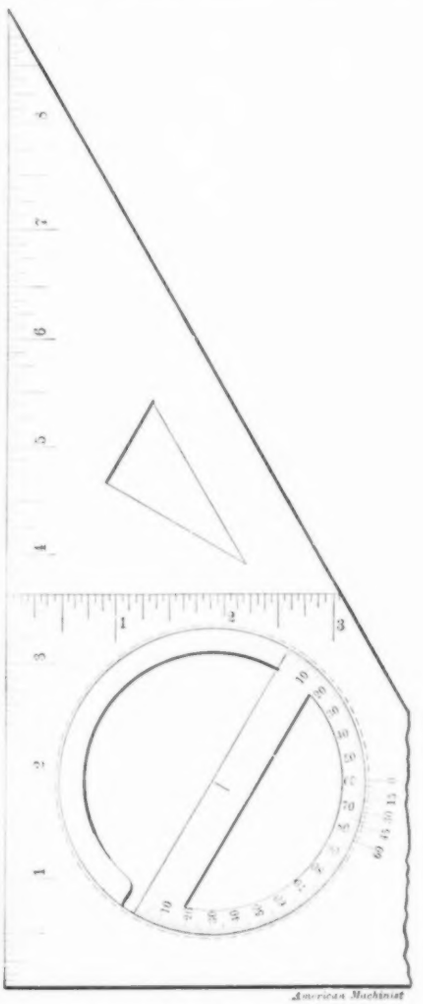


DONKEY WHEEL AT CARISBROOKE CASTLE.

A Draftsman's Triangle.

Editor American Machinist:

The accompanying sketch shows a celluloid triangle of my design, which may interest some of your readers. I find it very useful, and it is so simple that any draftsman can make it.



A DRAFTSMAN'S TRIANGLE.

The inches are graduated on the lower side, and by moving the T-square up and down lines can be scaled at the same time they are drawn, thus saving much of the erasing we have to do when following the old way.

Vertical lines up to 3 inches apart can be drawn very accurately if a little care is used when the graduating is done.

The protractor, although very small, is useful to quite an extent. It can be purchased of any dealer in draftsmen's supplies, the edge being beveled and sprung into place. E. A. CHAMBERLIN.

A Double Blanking Sectional Die and Punch.

Editor American Machinist:

I have often heard it said by first-class diemakers that sectional dies do not pay. Nevertheless, quite often we find it more advantageous to make them in sections than otherwise, on account of the difficult

contour or angles to be machined and filed. Then again, if we spoil a section in machining, filing, or even in hardening, it can be replaced more easily. We make sectional dies for double-acting cupping press tools and also in compound dies connected with the sub-press, both of which have been lately described quite fully in your columns.

In one of the departments of our factory they manufacture what are known to the trade as "school aids," which include geometrical surfaces and solids. The solids are made from well-seasoned hardwood, and the surfaces from what is commercially called "leather board," .028 inch thick. These are accurately cut with a sharp tool-steel punch and die. These tools, herein described, perhaps differ somewhat materially in detail from sectional dies hitherto described in the AMERICAN MACHINIST, therefore I submit a short description and shop sketch of a set

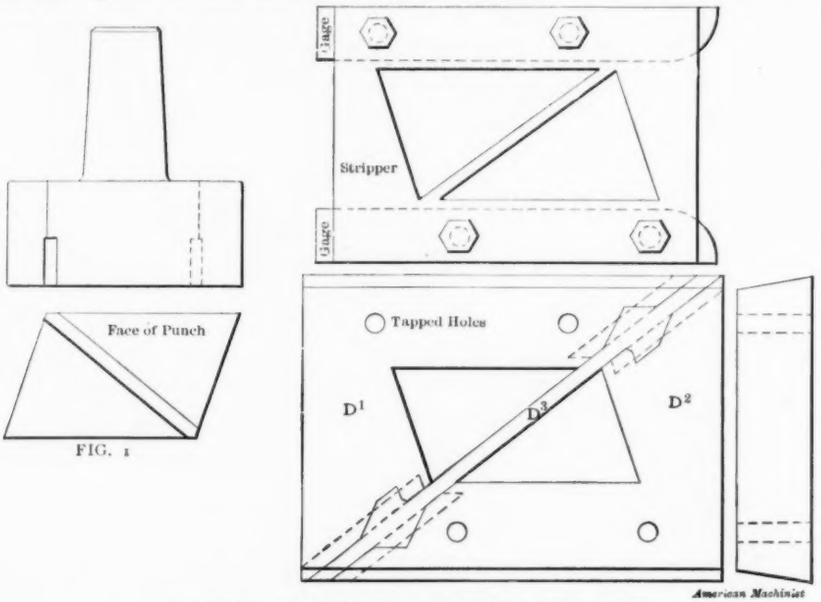


FIG. 1

A DOUBLE BLANKING SECTIONAL DIE AND PUNCH.

of these tools for blanking out two acute-angled isosceles triangles at each stroke of the power press.

Fig. 1 shows the blanking punch, which has 1 degree taper from its face back to the shank, thus allowing a small amount of stock to be shaved off in the screw press in accurately fitting the punch to the die after it (the die) has been hardened. The punch is *always* left soft in doing this class of work—"leather board" blanking.

Fig. 2 shows the die with its three sections, D^1, D^2 and D^3. The four independent locating keys that have their respective seats milled midway between the top and bottom of the sections D^1 and D^2 are shown in the sketch by the dotted lines; and the same in the center section D^3, also represented by dotted lines.

Above the die face are shown the gages with the stripper upon them. The gages are made of 3-16 inch stock, and the stripper from 3-32 inch cold rolled stock. Both are held in place by ¼-inch by 20 hexagon headed screws. The blanking part of the die has an internal clearance of one-half of a degree.

Perhaps the strangest part of the whole construction of this die was that the three sections were each made of a different make of tool steel. This was done to find out the real value of each. The steel used in section D^3 was of a brand that we could depend upon, as we had had quite a varied experience in its treatment. D^1 and D^2 were made from two new brands, each of whose merits were "painted in glowing colors" to the mechanical superintendent, so he ordered enough stock of each to make these tools, with special instructions as to how to harden them, but it may be as well not to publish the results.

Our open-back, single-acting blanking presses are equipped with an automatic, multiple-pawl, ratchet feed, by which device a small fractional part can be added to or subtracted from its length of feed. The several pawls are disengaged simultaneously by a lever. MATTATUCK.

Answers to Want Advertisements.

Editor American Machinist:

At various times I have had occasion to answer advertisements for draftsmen in the columns of the AMERICAN MACHINIST. In a majority of cases I never received a reply. I have spoken with several of my friends and find they have practically the same experience.

Two years ago there was a notable exception. Then I received replies to nearly every letter I wrote and was offered some good positions, one of which I accepted at four dollars per day.

When I have written to places I have heard of through other sources I have invariably received replies, sometimes to tell me that the vacancy was filled but that they would like to keep track of me for a time in case anything else turned up. Once I received a reply asking me to come and talk the matter over with them at their expense. This situation proved to be worth $1,500 and I secured it.

In answering an advertisement I generally give my age, nationality and outline of my experience, sometimes giving names of firms I have worked for. I do not know as this is wise. If recommendations are asked for I enclose them, but rather not, as I prefer to stand or fall solely on my own ability or to let my prospective employers look up my references themselves.

The question of salary expected always bothers me. One hundred dollars per month in some places is better than one hundred and twenty-five in others. Then people's ideas regarding the value of an experienced man vary so. Some think $15 or $18 per week enough, while others won't have a man that is worth less than $24. I generally try to avoid answering this question until I learn a little regarding the situation. Once in talking over a situation with the manager of a concern I set my price $2 per week more than I was willing to work for, as I had had some sad experience in places I had previously worked in. To my horror, he accepted my offer, though he said it was a good deal to pay for a man who had had no experience in his line of work; but he wanted a good man and believed I would make one. I assume that my work gave satisfaction, as in a little over a year my salary was increased. I would never have secured this situation if I had set my price way down.

But to return to the subject, why is it that firms refuse to answer letters from men replying to their advertisement for help, when if these same men write for catalogs of their products they will spend from 6 to 20 cents in stamps on them? It would seem that common decency would demand an acknowledgment of these letters. I used to enclose stamps, but soon learned better.

I once lost some valuable testimonials I sent to the president of a college who had advertised for a superintendent for his shops located in a central State west of the Mississippi, although I asked for their return. H. A. H.

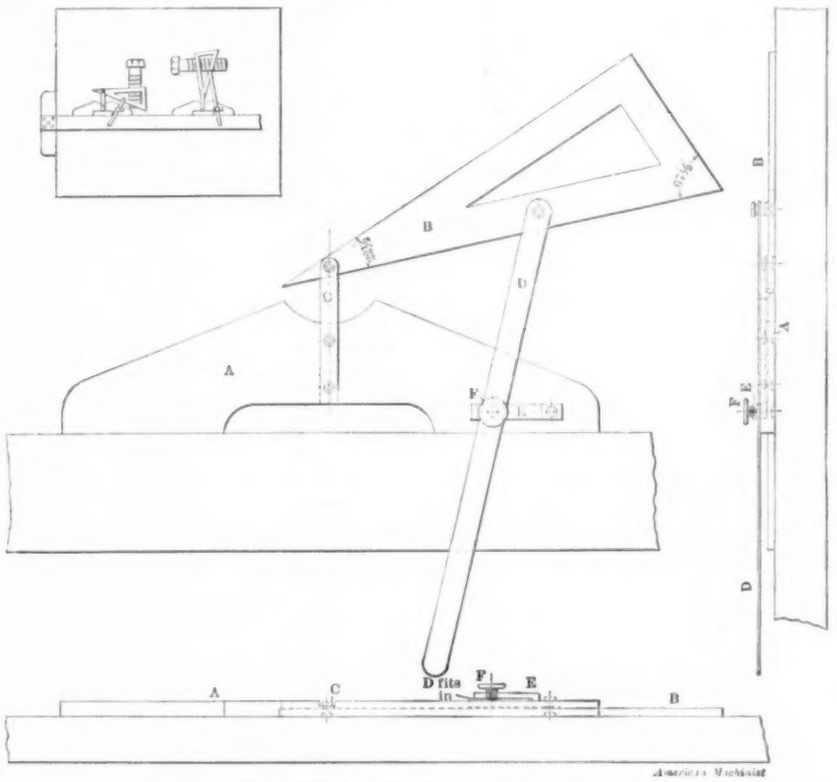
[This letter relates to a difficulty which very many of our readers have experienced and many of them have felt aggrieved; though, according to the letter of our correspondent the net result of his replying to advertisements appearing in the paper has been favorable. Many others have fared as well notwithstanding that there has been a good deal of complaint about the fact that replies are not generally received where advertisements of this character are answered. The reason given for this by manufacturers who advertise is that they usually receive a great many replies and that to answer each one makes their identity known to a great many people to

whom they do not wish to make it known, and a reply can in any event be of no substantial benefit. At any rate, it is a matter over which we have no control. We think every one who answers such an advertisement should make himself familiar with the note we publish at the head of these advertisements, and we do not believe that stamps should be enclosed or that it is any advantage to enclose them. If a business concern wishes to reply to an advertisement of this kind, it will not be burdensome to pay for the two-cent stamp necessary to place upon the letter, and they probably regard the enclosing of a stamp as simply an attempt to force them to reply—an attempt which in most cases they successfully resist. No original letters of reference or other papers of value should ever be enclosed to an unknown correspondent. Where such things are necessary, copies will answer just as well.—Ed.]

A Draftsman's Adjustable Triangle.

Editor American Machinist:

The accompanying sketch shows an adjustable triangle of my invention. The base *A* is made of wood and shaped as



DRAFTSMAN'S ADJUSTABLE TRIANGLE.

shown. *B* is a triangle of 22½ or 30 degrees and of wood. *C* and *D* are hack-saw blades, ground, polished and drilled for small screws. *E* is made of ¼-inch square steel, shaped as shown. *F* is a large thumb screw.

I have one with both 22½-degree and 30-degree triangles, and find the 30-degree the handier. I have been using it daily for about a year, and find it very useful. Many times the usual 45-, 30- and 60-degree triangles cannot be used unless shifted and held by the hand, but with the adjustable triangle the angle is first found, and the triangle then set, giving at the same time the right angle to the line. The smaller view shows the use of the instrument in drawing threads.

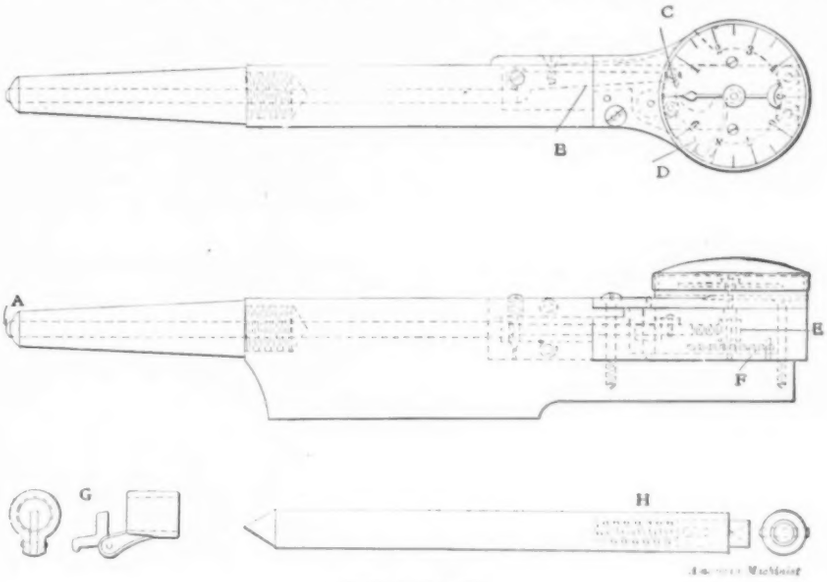
A. W. McALPINE.

A Test Indicator.

Editor American Machinist:

The accompanying drawing illustrates an indicator which I designed and made. The important feature of this tool is the dial, which, though only 1⅛ inches diameter, gives room to show errors highly magnified, the ratio being 350 to 1.

The graduations read in half-thousandths, but quarter-thousandths, or even



A TEST INDICATOR.

smaller amounts, can easily be estimated. The limit is ten one-thousandths—or one turn of the pointer. When in use, the plunger *A* touches the work, and any imperfection will cause it to move the lever *B*, which, through link *C*, actuates the gear segment *D* and rotates the pinion *E* with the spindle carrying the pointer. The latter is returned to zero by a volute spring *F*.

The attachment *G* is used for inside work, or for testing any surface at right angles to the indicator. The tool *H* is used in testing centers in lathe work held on the face-plate or in the chuck.

All working parts are encased, and the dial is covered with a heavy watch crystal, which makes it dust proof. A watch crystal may seem out of place in a machinist's kit, but it is a good thing, if for no other reason than that it silently demands the careful treatment such a tool deserves.

This indicator is not only adapted to lathe work, but is often found very useful when setting work in the shaper or planer, and especially in setting shaper vises perfectly true. C. HAMER.

Circular Planing.

Editor American Machinist:

The sketch of the arc planing at page 1773, Vol. 26, reminds me. Being superintendent of a rolling mill near Chicago, I had to do with an engine journal brass for a 15-inch shaft which needed overhauling. The "boys" said none of our tools would bore it, and were at it with hand tools when I had it put on the planer, set the tool so that the radius to the center of the swivel plate was right, put leather washers behind the hold-down nuts of the swivel plate, set the friction tight and with

a wooden mallet swung it around for the cut at each stroke, and made a fine job.

"Bert" came up with a long face a few days ago with one of those castings that "couldn't be machined in our tools," but, under the Old Man's ideas, he soon had a cast-iron collar fitting the Hendey shaper tool-post, with a tool on one side and a ¾-inch lever on the other side to strike against, a leather washer in front and a bar across the tool slot holding the collar. He soon bobbed up with "All done, sir."

POWER.

Turning Bosses in the Upright Drill.

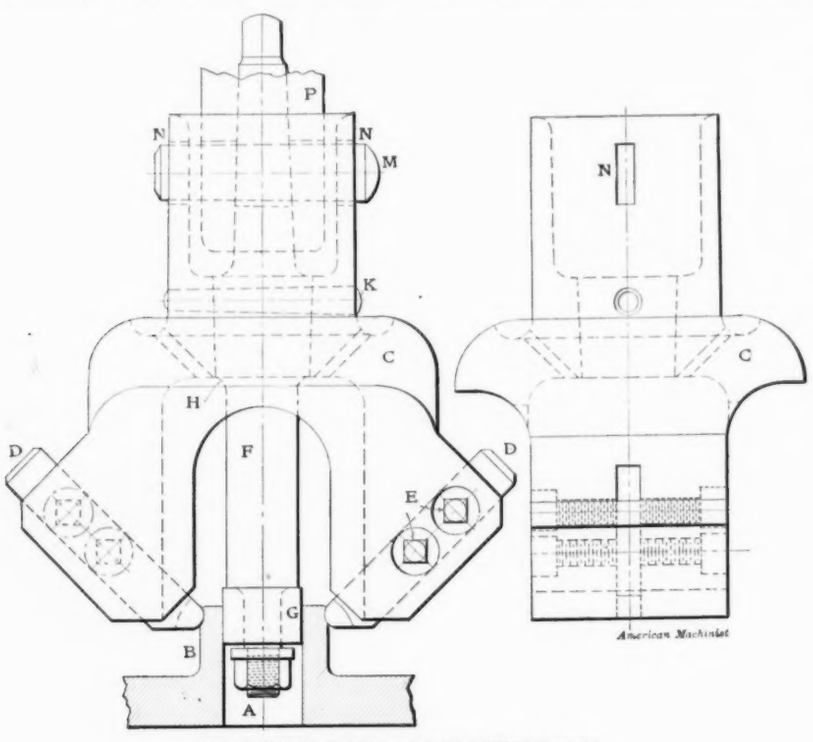
Editor American Machinist:

Shops frequently have plenty of work for their lathes and not quite enough to keep the drill-press hands busy. The sketch shows how the work of turning bosses can be done on the drill press quicker than in the lathe. Large castings that will not swing in the lathe can be set under the drill, and when the hole, as *A*, is drilled, and without removing or resetting the work, the cat-head *C* can replace the drill socket and boss *B* may be turned to the proper diameter.

The body C of the tool may be made from either a forging or a casting. Two self-hardening steel cutting tools *D* are used and can be easily set by means of the set-screws *E*. Where the bosses to be turned have been bored the extension arbor *F* may be used also as a guide with a guide bushing *G*, made to fit the hole. Should the bosses be long and not to be bored, then the arbor may be cut off at *H*, the end of the taper fit.

The arbor is fastened to the body *C* by the taper pin *K*. The key *M*, which locks the drill spindle *P* to the shank of arbor *F*, also extends at each end through the body at *N*, thus removing the torsional stress from the shank.

A large number of these tools are in use by a locomotive works and are giving the very best results. T. B. BURNITE.

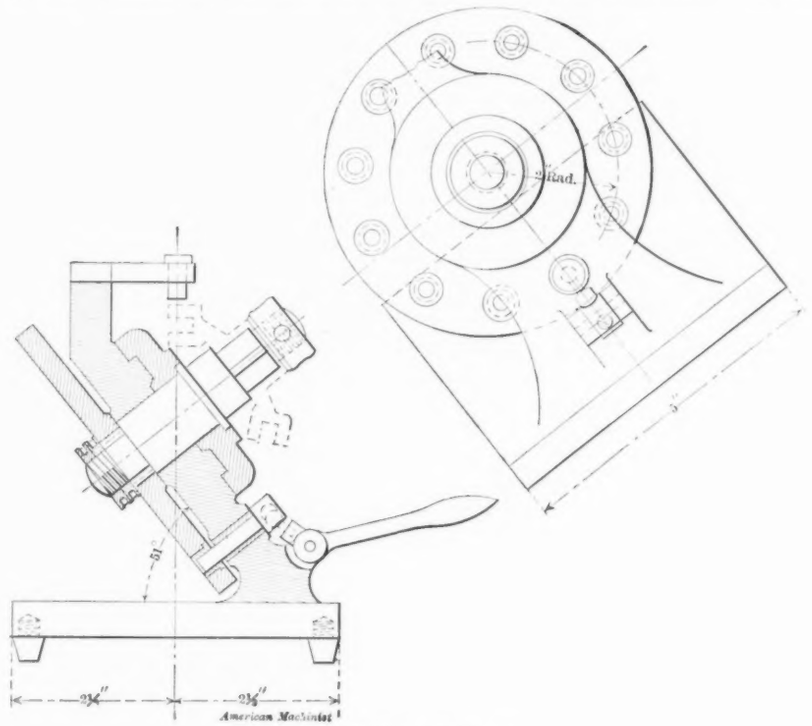


FOR TURNING BOSSES ON THE UPRIGHT DRILL.

An Indexing Drill Jig.

Editor American Machinist:

The fixture shown herewith was designed for drilling eleven holes through a formed piece of steel, the holes being equal distances apart and at an angle of 51 degrees with the center line. The sectional view will give the reader a very clear idea of its construction. The stud on which the work fits is hardened and ground, and on this same stud fits also the index plate and the upper bearing plate; the latter serving as a thrust bearing to take the downward pressure of the drill. The index plate is made of steel and has eleven hardened and lapped bushings inserted into it; the periphery of the plate is knurled so that the operator can manipulate it with ease. A flat spring under the handle that operates the locking pin and which is not shown in the print, serves to hold the pin always in position. The fixture has four feet which rest on the drill press platen. I think further explanation unnecessary, as the blueprint is reasonably clear. JOS. M. STABEL.



AN INDEXING DRILL JIG.

Tests of Drop Hammers by the Compression of Copper Cylinders.

Editor American Machinist:

I remember well the tests made by Professor Thurston in 1883 and published for the first time at page 1806, Vol. 26, and would say that the conditions under which the tests were made render them of no practical value. Professor Thurston was employed by the Stiles & Parker Press Company to make the experiments. The makers of the crank lifters were not asked to be present to see that the conditions were fair, and I claim that they were not fair. The Stiles friction drop hammers used in the test were designed entire by the makers, while the anvils, and in fact all the machinery, with the exception of the lifters used in connection with the crank lifters, were not designed by the

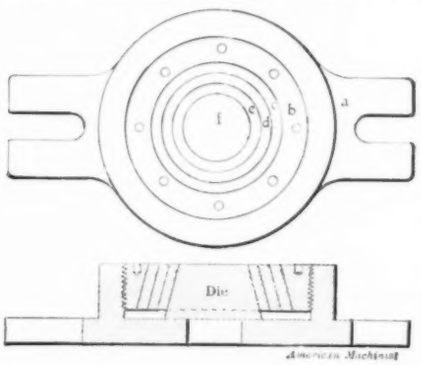
makers of the lifters. It is a well-known fact that the weight of anvils and the form of foundation exert a great influence on the effect of the hammer on the work, and in this case the anvils used with the crank lifters at least were not up to the standard for weight. Where the conditions are equal as to proportion of weight of anvil to that of hammer, and with same foundation there cannot possibly be such a difference (if any at all) between the two types of drop lifters. I know this from the fact that where crank lifters have replaced "used-up" friction drop lifters the results have differed imperceptibly as to force of blow. I think, of course, that Professor Thurston made a fair test, as he understood the conditions, but he was given the data regarding these machines, that applied only to the weight of hammer and hight of blow, and the matter of comparative weights of anvils, foundations and other conditions that I will not speak of now, were not brought up. He evidently did not have a practical knowledge of the working of the respective types of lifters or he would not have remarked on the "evident cost of the wear and tear on the lifting belt," for it is well known by those using both types of lifters that the cost of wear and tear on boards used in friction lifters far exceeds that of belts in crank lifters. Knowing the conditions of the test I must emphatically repeat that the tests made at that time have no practicable value as showing the comparative efficiency of the two types of drop lifters. GEORGE WM. PECK.

New Haven, Conn.

A Bolster for Holding Round Dies of Different Diameters.

Editor American Machinist:

It is generally the case that in looking for a die bed, or bolster, in the press room one always finds everything but what is wanted. The sketch will show



THE BOLSTER WITH RINGS AND DIE BLANK IN POSITION.

how to overcome this difficulty to a certain extent, as one bolster takes the place of many.

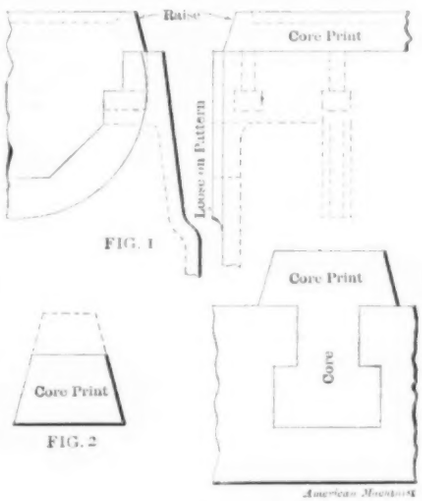
The block *a* is made of cast iron; the rings *c*, *d* and *e* are of machine steel, each 1 inch larger than the one it fits over, and turned taper inside and out, the ring *b* screwing into *a* having spanner wrench holes drilled in its upper face.

By screwing down ring *b* all are clamped securely together. At *f* is shown the smallest die held in place. The object in having the rings is to enable one to remove any ring and replace the same with the die. The die blanks can be turned to fit duplicate rings and kept in stock. This arrangement will be found very handy when trimming shells or handling work of a like nature. G. K. STEVENSON.

Core-Print and Core-Box Suggestions.

Editor American Machinist:

With few exceptions shop foremen allow their workmen to use their own judgment regarding core prints and boxes, and this



CORE-PRINT SUGGESTIONS.

as a rule is a mistake. If a standard were followed there would be more interchangeability and alterations would be simpler.

A good proportion for the standard core print is as per Fig. 2. Take the diameter of the core for the base and hight of layout, one-half the diameter for the smaller end, and then use that portion of the layout for hight of print that the case may require.

The setting of deep cores, especially where they cut through the outer wall of metal, as on bearings of engines and beds, etc., is often interfered with by sand being disturbed and falling to the seat of the core. This can be avoided by placing a slight raise around the edge of the print, as then any sand disturbed will fall below seat of core; see Fig. 1.

Time, strength and material can be saved by making core boxes rectangular, wherever the case permits, and dropping in loose pieces for the desired form. Where a temporary box is required the frame can often be worked over and the material saved. This also generally makes a convenient box for the coremaker, as the frame can first be withdrawn and the loose pieces then picked out with less chance of disturbing the core.

Fig. 3 shows a practical way of making the print and coring T-bolt head slots and other cores having overhang with small surface for setting the same. Make the print slightly wider than the head of core, exposing more surface of the former to the flow of the metal, which will hold the core in position without the use of chaplets.

The detailing of large core boxes from the drawing by pricking the outline of the same will be found very convenient and helpful, as it places before one what is required for the box construction. Place heavy paper underneath that portion of the drawing which contains the core to be made, and thumb-tack both to the board. With a needle prick outline of plan and elevation, also section or sections of the core, as the case requires, pencil in the pricked outline of the different views, allow for core prints, and draw the outline of box or frame around the same, showing the required filling. H. J. MCCASLIN.

Automobile Road Train.

On January 14 a party of about sixty newspaper and technical journal representatives, automobilists and others, were conveyed by special car from Long Island City to the works of the Gibbs Engineering & Manufacturing Company at Glendale, L. I., to witness the operation of their tractor road train, the demonstration being followed by a luncheon which was served in the new shops, and the party then returning to this city.

Owing to the exceedingly bad condition of the roads in the vicinity of the works, these highways being coated with glare ice in spots and at other points being inches deep with slush, it was found practically impossible to drive the train for any great distance; it was sufficiently demonstrated, however, that the train had ample power to operate it under anything like reasonable working conditions. Although from its name one might infer that the tractor hauled the entire train, each wagon is practically self-propelled, the tractor being really a generating plant from which electric current is supplied to motors under each of the two trail cars as well as to its own driving motors. A three-cylinder, four-cycle, 40 horse-power gasoline engine and a direct-connected 30-kilowatt generator constitute the generating set and furnish a 220-volt direct current to a pair of 6 horse-power motors under the tractor and to the two 5 horse-power motors with which each trail car is equipped. The tractor motors are connected by gearing—giving a speed reduction of 26 to 1—to the forward wheels, the steering being accomplished by means of the rear wheels. The trail cars are, of course, driven from the rear, and motors and rear wheel sprockets are connected by roller chains of 2 inches pitch, the speed reduction here being about 45 to 1. The tractor has a wheel base of 6 feet, its gage is 6 feet and its weight 6 tons. Its driving and steering wheels are respectively 36 and 32 inches in diameter and provided with 7

and 3½-inch solid rubber tires. The tank for the gasoline has a capacity of 30 gallons, and the water tank will hold 50 gallons. The gasoline engine has 7x10-inch cylinders and runs at 400 revolutions per minute. One of the interesting features of this engine is that the tappets for operating the intake and exhaust valves are carried by a swinging head which may be tilted back by loosening a couple of nuts, to give access at any time to the valves. The valves are also easily removed, if necessary, by simply turning a nut and swinging a clamp round so as to clear the stems. The trail car gage is 6 feet 9 inches, the wheel base 10 feet, the weight of each car 2½ tons and the carrying capacity per car 10 tons. The driving wheels of these cars are 56 inches diameter, the steering wheels 38 inches, and the tires, which are of flat steel, are 5 inches in width. This particular train has been constructed for a Canadian concern, the Massey Station Mining Company; it has a speed of four miles per hour and will be employed in transporting ore and supplies. A longer train now under construction for the Pacific Borax Company will have seven trail cars and the generator in the tractor will be driven by a six-cylinder gasoline engine of 150 horse-power. The train will take the place of the mule teams now used in transporting borax across the Mojave Desert from Death Valley, California, and will have a haul of 125 miles, that being the distance from certain recently discovered and valuable deposits to the nearest railroad shipping point.

Universal Belt Drive for Small Tools.

The accompanying views show a universal tool drive the design of which has been submitted by Félix Fromholt to the Society of Encouragement of National Industry, in France, favorably reported on by one of their committees and published in their *Bulletin*. While not of striking originality, the device shows a felicitous arrangement of belting to secure range and flexibility of movement.

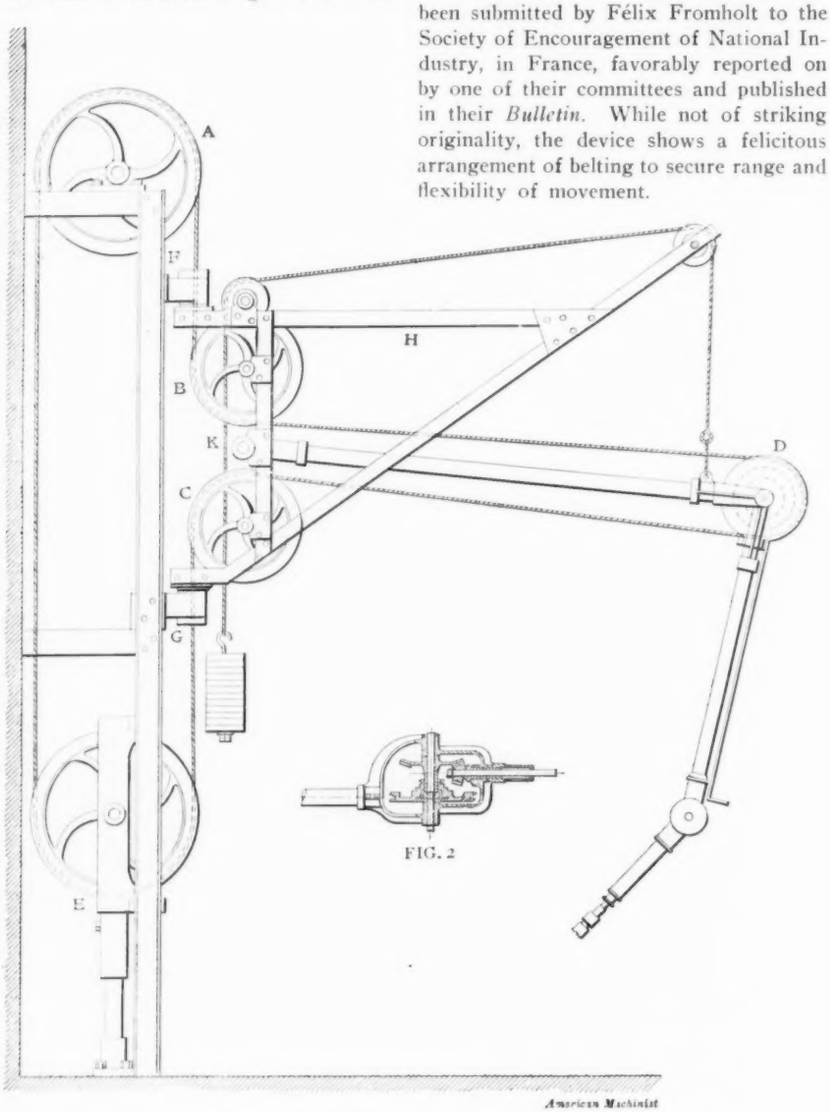


FIG. 1. UNIVERSAL BELT DRIVE.

FIG. 2

Referring to Fig. 1, sheave *A* is driven in any convenient manner from the source of power. From this pulley a round belt passes over pulleys *B*, *D*, *C* and *E*, then back to *A*, going, on its way, through holes in sockets *F* and *G*, which pivot the frame *H*, supporting the tool with its jointed shaft. This shaft is pivoted in a vertical plane at *K* and balanced by a weight. The belt tension is maintained by the weight of pulley *E*, suitably loaded, held in guides and provided with an air cushion to receive the shock if the belt break. It is obvious, however, aside from this compensating feature, that the tension of the belt is independent of the position of the tool.

Pulley *D* is free on its axle and drives the rotating shaft of the tool by the bevel gear arrangement shown in Fig. 2. The clutch for setting the tool in motion or stopping it is here.

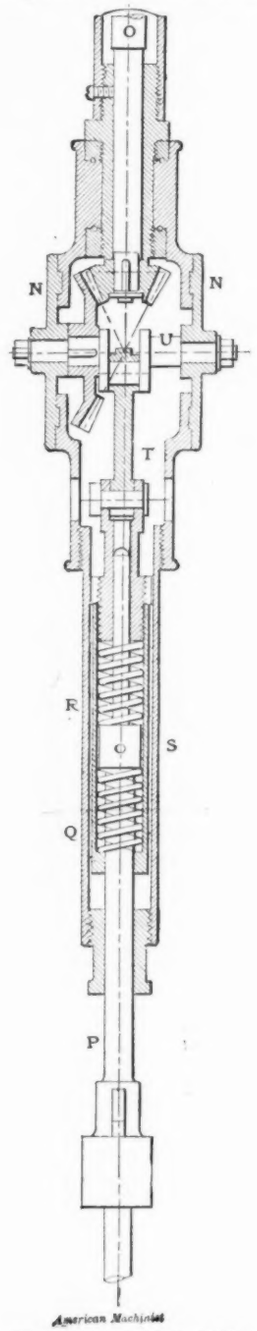


FIG. 3. ARRANGEMENT FOR PERCUSSION TOOL.

The drive is suited to the use of holders for either rotary or percussion tools. A holder for the latter sort is shown in Fig. 3. The rotary movement of shaft *O* is converted into a reciprocating one by bevel gears and crank at *V* and connecting rod *T*, which is not directly attached to the rod

carrying the tool, but to a cylindrical box sliding in the casing. In this box are helical springs *Q* and *R* which support the tool-carrying rod by the ring *S*. The casing of the tool holder is allowed a swiveling movement on ball bearings and is also jointed around *U* in a plane passing through the axis of the tool.

There are suggested several variations of the machine, such as the use of devices to give the percussion tool a rotary, as well as a reciprocating motion; the employment of friction wheels instead of toothed ones in the holder designed for rotary tools, if intended for high-speed work, or the arrangement of a belt connection from wheel *D*, doing away with the bevel gears. The entire machine may be attached to a post or wall, as shown in Fig. 1, or mounted on a truck.

M. Fromholt's address is 32 Boulevard Ornano, Paris.

Echoes From the Oil Country—Laying Out a Derrick.

BY W. OSBORNE.

At page 1464, Vol. 26, Mr. L. L. Arnold tells of how Mike laid out a derrick for them, and, after telling his own experience in laying out and building one, expressed a desire to find out how Hank would go at it. As a derrick might be needed for a variety of purposes besides drilling oil wells, I thought the subject might interest others besides Mr. Arnold, so I went to other experts in that line as well as to Hank, and will try to tell how it is done up here. Though it is not strictly in our line, it is an interesting mechanical operation.

To begin with, there are good and bad rig builders who build good and bad derricks, and some of the bad derricks have the same traits up here that Mr. Arnold so feelingly described. I have heard the work of a certain poor rig builder described thus: "His derricks are so blamed crooked that it is hard to get the tools to hang inside of the derrick floor, and you can't tell which end is the biggest without measuring." Personally I think that this is exaggerated, although there is quite a variety.

Most rig builders make and work to a "derrick draft," more or less accurately made and more or less closely worked to. A very common plan is to draw it out on a board, sometimes 6 or 7 feet long, and take this board along and get the angles and measurements from it. When the measurements are proven to be right they are marked on the board for future use.

Others use a more condensed drawing, that can be made to a larger scale, and yet occupies much less room. This is the kind in most common use. It is easy to make and not hard to carry, even if made on a board. The board seems to be the most popular, as being easier to take the angles from and able to stand rougher usage, although many use paper.

Concerning the drawings shown, I will explain that there are some things that are alike on all derricks and some things that have very little uniformity. A derrick is 20 feet square at the base; the top may be almost any size from 6 feet or over down to 2 feet 10 inches or under, although for drilling they are generally near to 4 feet. The hight may be 32, 42, 50, 58, 66, 72, 74,

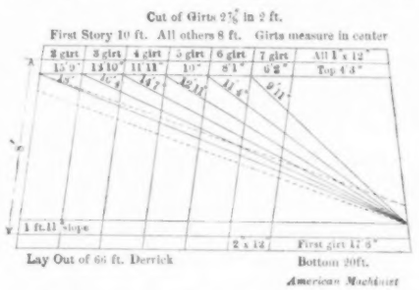


FIG. 1. LAYING OUT A DERRICK.

80 or 84 feet, or any intermediate size, while the top, to go with the hight, seems to be a matter of individual fancy. Some short ones look like tall ones that have been cut off to the length wanted (which is often done after the well is drilled), while others have very small tops. From this it will be seen that a man doing rig building for the general community has to have a variety of drafts, or else must refuse to make any but what are, to him, standard derricks.

No matter what the hight of the derrick, it is 10 feet up the leg to the first girt (center) and 8 feet between the ones above that. The joints in the legs come at the centers of the girts, and are staggered so as to break joints. A leg is started with a 10-foot and an 18-foot piece and then continued with 16-foot st ff.

The only gage that I have been able to find is a little different from Mike's, but is a very good tool, and if a man had a number of derricks of the same size to make, it would well repay for the time spent in making it. I think that the drawings will show its construction plainly enough to enable an interested party to make one.

I have not shown a drawing of a derrick where it is stretched out on a board, but Fig. 1 is a condensed drawing that shows all that the other kind does, and can be put down on a much larger scale and on a much smaller board, so that it is much better in both ways. A very common scale is an inch to the foot, which does not make it big enough to be clumsy, while large enough to scale readily and to a size that is not liable to cause mistakes.

Brace Cuts

1st Set	18′	4–7¼	4–14¼	2″ x 6″
2nd "	16′ 4″	4–6¾	4–12½	
3d "	14′ 7″	4–5¾	4–10¼	
4th "	12′ 11″	4–5	4– 8½	1″ x 6″
5th "	11′ 4″	4–4¼	4– 7¼	
6th "	9′ 11″	4–3¾	4– 5½	

This list of brace cuts goes with Fig. 1. It will be seen that the measurements are taken up the leg, so that a 66-foot derrick is not 66 feet in vertical hight, but the leg is 66 feet long. The lengths of the girts are taken at the center in this drawing, although many rig builders put the size of the bottom on the drawing as being easier to work to. The length of the braces is taken diagonally across the board used, as the dotted lines show at the lower brace. These lines also show the position of the brace in relation to the leg and the girt. The table of brace cuts shows the settings for the cuts on the ends of the braces. The sizes are those furnished on the draft that was given to me by the rig builder, and I have not yet had to try to build a derrick from them, but would not hesitate to use them if I had such a job to do. It might interest some mathematician who is looking for something to practice on, to figure out the proper angles and find out how far these are off. I would say that a great many derricks are built where very little attention is paid to the fit of the braces, and as the lumber is all rough, and some of it very rough, it is a waste of time to try to work things down too fine. In cutting the girts and the braces, allowance has to be made on half of them for the thickness of the stuff, as one half

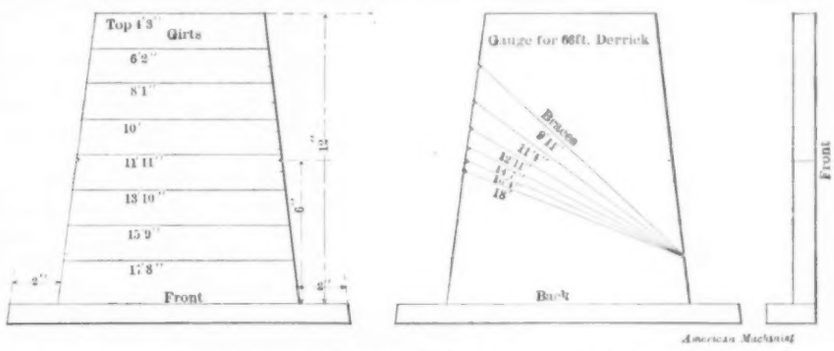


FIG. 2. DERRICK GAGE WITH ANGLES FOR GIRTS AND BRACES.

reach clear to the legs, while the others reach only to these.

Fig. 2 shows a derrick gage that gives the angles for the girts and braces without the use of a square. This gage is of any desired kind or thickness of wood that will keep its shape well, and is made 12 inches long from the foot up. The width can be anything convenient, but in this one it is made 10 inches at the base. The

angle of the sides must be accurate, and is taken from a careful layout of a derrick of the hight and size of top that it is to be used for. The lines on the front have the lengths of the braces marked out on them as shown. Six inches up from the foot a nick is cut on each side. These nicks are used to center the girts. On the back side of the gage the angles of the braces are all carefully laid out from a common starting point. At this point a saw cut is run across the edge, so that the point may be made to come to a line when the gage is laid o a board. A saw cut is made also at the point where each of the lines comes at the other edge of the gage. The foot is wide enough to extend back of the board, is 4 inches longer than the gage is wide at the bottom, and extends by 2 inches on each end. This one is for a 66-foot derrick with a 4-foot 3-inch top.

By laying the edge even with one side of a 2x12-inch that is to be used for the bottom of a leg (see Fig. 3), the lower side will make the angle for the end so that it will set flat. The front of the gage should be next to the plank. To lay out a girt, lay the gage front side up on the piece to be laid out, with the foot against the lower side. Mark off the angle of the end from the side. By using the nick that is in the center, mark the center of the girt at that end, and if the piece should happen to be more than 12 inches wide, using the top as a gage, mark off the proper width. Moving to the other end a center line is struck on which to measure the length, and when that is measured off the angle of that end is marked.

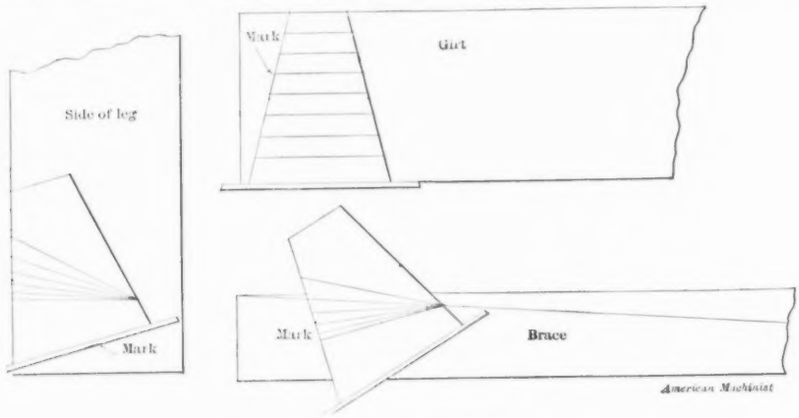


FIG. 3. SHOWING THE USE OF THE GAGE.

It will be remembered that the braces are measured diagonally, and not in line with one side. Using one of the braces for a straight-edge, the line of this measurement is marked for a short distance at each end.

If it is the lower brace that is being laid out, the back of the gage is turned up and the lower brace line across it is made to coincide with the diagonal line on the brace, and the angle of one end is marked.

By moving to the other end of the brace and using the same line on the gage the other end is laid out by the other edge of the gage. The remainder of the braces are laid out in the same way, using the other lines for the braces that the angles were drawn for. In Fig. 3 the next to the top brace is being laid out.

In building the derrick two of the girts in any set go up to the corner, and the other two come against these, and so, as the derrick is square, two in each set are 4 inches shorter than the other two. The measurements given are for the longest ones. The four are laid on a pile together and the top one is laid out, and one end of them all is sawed off. The other end is sawed off down through two of them, and then these two are moved back 4 inches and the other two are sawed off.

The braces are laid out and sawed in the same way; but there are eight of them, and four are shorter than the other four—on the two lower courses 4 inches, and on the others 2 inches. In moving back to saw the short ones, the 2-inch projection on the bottom of the gage can be used to measure the set-back if desired. It is made 2 inches for that purpose. If the lumber comes very uneven in thickness, allowance must be made for it in the set-back, or the braces will be too long.

In building the derrick the corners are started, as was said before, with a 10-foot and an 18-foot piece. The first row of girts are put in and used to hold the scaffold used to run the corners up a joint and to put in the braces. The center of this platform is found, and it is made to stand directly over a center mark on the floor. In running the derrick the girt is put up, and then its braces under it. If the legs do not show straight they are pulled into place by the braces. The top of the brace is always nailed first. Where a leg leans, the top of the brace is nailed on the one that leans in, and if putting the other end in does not bring it straight, the bottom of the brace is pulled up until it is straight, unless it is too long; in which case a bit of the point is nipped off with the hatchet that is used as a hammer. The "lining" is done by eye, and is done by the man on the ground. The long girts and braces of each set are not put on the same side all the way up. The long ones will be used on one section, and the short ones on the next, and so on all the way up.

While there are many little "wrinkles" and "kinks" that help to make this work easier to do, I think that I have shown enough to enable Mr. Arnold to build his next derrick without having it resemble a corkscrew, or having the top twist around as though it was trying to find the north star. Do not try to scale the sketches shown, but make a careful draft and work to it.

The bottom of the derrick is composed of two main sills and six floor sills, and the floor is of plank. It is from 2 to 4 inches higher in the center than at the edges.

Three men, used to working together, will frame the sills, put them in place, lay out and cut the lumber and build the derrick in a day, for record time. There is a ladder up one side. It is made of 2"x4" for the sides and 1"x3"x2' for the steps.

Drawn Bars of Round and Rectangular Sections.

BY AMOS PRICE.

Manufacturers now buy many parts of their machines, and find it a decided advantage to do so, both in point of economy and fitness for their uses. In this respect, cold rolled and drawn shafting, owing to its greater strength and rigidity and superior finish, is practically the only line shafting below 4 inches in diameter now used, and is being adopted for all solid cylinders that are made of wrought iron or steel, such as piston rods, valve stems, rocker shafts, pins and rivets. The demand for engine lathes and machinists is not largely affected by this innovation, but the unskilled laborer is having levers put in his hands, and with them is putting machinists out of business. The handyman is destined to play an important part in building and operating machinery; but the brainy machinist who is willing and loves to work will be well paid and always out of sight of the aforesaid hyphenized individual.

Through the courtesy of Mr. Andrew Lawton, superintendent of the shafting department of the Republic Iron & Steel Company, I am enabled to give the following description of the way round and other bars are made.

The stock is point 1 to point 25 steel, and is first pickled and washed, a process which removes all the scale from the bars. The rounds are drawn through dies 1-16 inch smaller in diameter than they were rolled, and other shapes are reduced a similar amount. They are then machined, straightened, hand straightened, cut to length, doped with oil to prevent rusting and then stocked or shipped.

The pickling operation consists of soaking 10 to 15 tons of stock in a solution of sulphuric acid and water for four or five hours, washing with water and then through a bath of limewater, the washing being a continuous performance, one bar following the other through the tanks.

Care is taken to see that nothing sticks to the bars that can mark them while passing through the die. As illustrating the necessity of cleanness in this respect, if we chalkmark or tie a hair or a thread around the bar, traces of them are visible on it after passing through the die. It would be hard to guess at the depth of these marks, owing to their extreme shallowness.

Mr. Lawton makes his dies for rounds, out of car wheels, and chills the metal around the hole. Fig. 1 shows a 3-inch

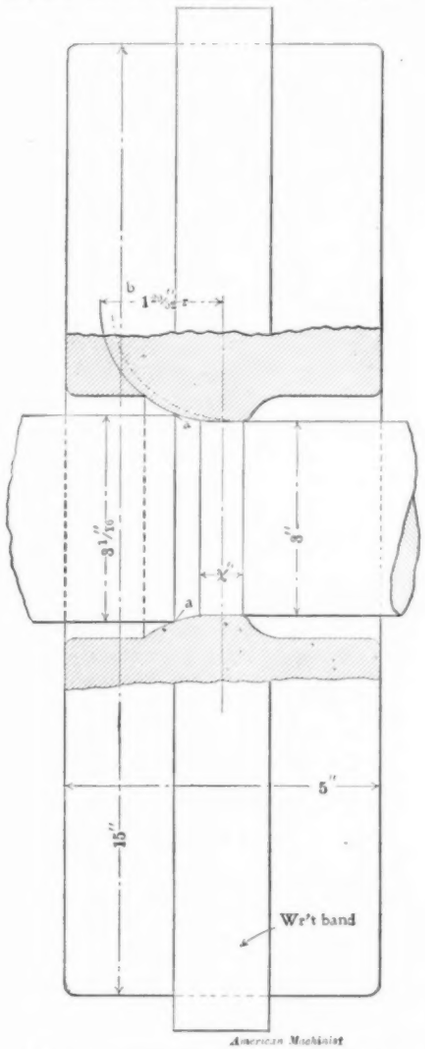


FIG. 1. CHILLED IRON DRAWING DIE FOR ROUND BARS.

die. For about ¾ inch the hole is parallel, then bell-mouthed to a 1 29-32 inch radius. As the shoulder at *a* gets dull it is ground or reamed sharp, as represented by the dotted line *b*. When but about ⅛ inch of the cylindrical part of the hole is left, the die is enlarged for another size, and so on, as long as the chilled part lasts. A wrought-iron or steel band shrunk on materially strengthens the die.

Shafting commercially known as 3-inch is, as nearly as can be made, 2.9985 inches in diameter. The cylindrical part of the hole in the die is 2.994 inches in diameter. There is no measurable outside expansion of the die and the inside is not get-at-able. It is probably more than the contraction of the bar; the latter expands some as soon as free from the die. The increased density of the bar, due to drawing, can only be determined approximately by its elongation, owing to its initial roughness and irregularities; the bars also do not stretch alike. The well-marked results of the drawing are increased strength and stiffness, and a great decrease in ductility. Occasionally a bar breaks while being pulled through the die, and the fracture, except in color and texture, resembles that of hard cast iron, although before it was put in the drawing machine it would have stretched 25 per cent. without breaking. The larger the bar, other things being equal, the more liable it is to break by drawing, although the reduction is the same, 1-16 inch in all sizes from ¾ inch to 5 inches.

As illustrating how nearly bars are tortured to destruction by drawing, Mr. Lawton tells of a Boston customer, a few years ago, who bought his rough bars of them and did his own finishing. He had trouble from the bars breaking when in the straightener, and Mr. Lawton went to his works to investigate the cause. He found that the bars had been drawn one day and straightened the next day or the day after. His opinion was that the bars should be straightened as soon as drawn, not giving the fibers time to set or polarize in the position they were in when leaving the die. Subsequent drawing and straightening of the bars out of the same lot without breaking verified Mr. Lawton's opinion.

The pull required to draw a 1 1-16 inch bar through an inch die is 15,000 pounds, and 30,000 pounds to draw a 2 1-16 inch bar through a 2-inch die, showing that the pull varies as the diameter or periphery, and not as the area of the bar, as some might suppose. Bars are often drawn with a much greater reduction than 1-16 inch, and the changes due to drawing vary somewhat with the amount of reduction. High carbon bars go through the die on the jump, and leave well-defined swells on them where they stop in the die for an instant. Rods ¾ inch and below are pulled four at a time, with a reduction of 1-32 inch. Above ¾ inch and up to 1⅞ inches two bars are drawn at a time. All bars are more or less kinked in drawing, and, although the pull tends to keep them straight, when they fall from the die they assume all kinds of crooks. When several are being pulled at once some can be felt lagging behind, and presently going ahead of the others, although the grips do not allow much variation in this respect. One peculiarity noticeable in drawing the bars through the dies is the ease with which they can be rotated. One may grasp an inch rod with the hand tight enough to twist it perceptibly in the die, as far as the grips permit. This is another example

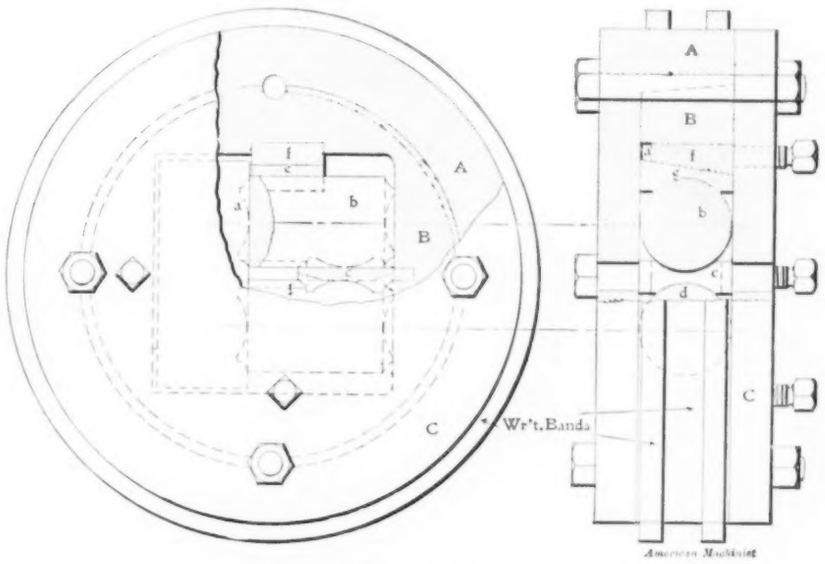


FIG. 2. DIE FOR RECTANGULAR BARS.

wherein longitudinal motion eliminates cylindrical friction. On the other hand, if the rod is rotated in the die a force of 1 pound will, in time, pull or wear it through. Bars are drawn through the die at about 17 feet per minute, and at this speed it requires about 1 horse-power, net, to pull a 1¼-inch bar. A stream of black oil lubricates the die and rod.

Mr. Lawton says that, in his experience, chilled dies last about ten times as long as those he has made of tool steel, and he assigns as a reason that unlike metals wear better than like surfaces. The only exception which I know to this rule is the case of cast iron on cast iron. It is the least quarrelsome of all the metals, with itself or with others. The number of feet pulled through a 1¼-inch die varies largely, but 4,000 feet may be taken as the average without sharpening.

Fig. 2 shows Mr. Lawton's die for drawing "flats," or rectangular sections. The frame pieces *A B C* are bolted to-

gether, as shown, *A* and *C* having holes at their centers for the bar to pass through. The die proper is formed of the solid cylinders *a b c d*, all having a common diameter of 3 13-16 inches, and the bases or ends of *b c d* are bored out at right angles to their axes, to a radius of 1 29-32 inches, so that the base of one cylinder will fit the cylindrical part of another, and when arranged as in the figure will make a bar 2x½ inch. The length of *c* cylinder determines the thickness of the bar, the length of the others is immaterial.

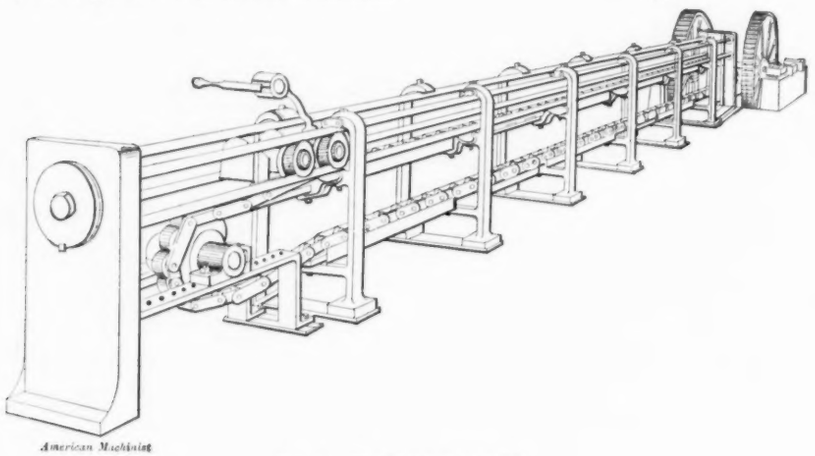


FIG. 3. DRAWING MACHINE.

It will be seen that cylinder *a* may easily have twenty or more wearing places, while *b d* each have sixteen, and *c* eight wearing spots without grinding. When the die gets dull on one side, it is faced about, and the bar is drawn through from the other side. The die is adjusted with setscrews acting on wedges and dutchmen *f* and *e*, respectively, behind each cylinder, these not shown except at *b* cylinder. The work turned out of this die is first class, the surfaces are true and smooth, and the corners clean and sharp. It will be seen that by suitably grooving *a* and *c* cylinders, hexagon, octagon or oval bars may be drawn through this die, but not with so many advantages as bars having a rectangular cross-section. Mr. Lawton may very appropriately call it a universal die.

The machine for drawing the bars is constructed of two horizontal columns made of five T-rails each disposed to admit a carriage between them. One end of this double column receives the die and supports an idler sprocket wheel and shaft, while the driving sprocket wheel and shaft are located at the other end of the column. These sprocket wheels carry a sprocket chain made of links 6x1¾x10-inch centers, 2-inch rivets. The carriage is provided with a hook to engage the chain to pull with, and lets go when there is no tension on the chain. The carriage is also provided with wedge dies, taper 1 in 6, which grip the reduced end of the bar and pull it through the drawing die and let go of it, owing to the general shake or recoil, when the bar leaves the drawing die. Fig. 3 (taken from the Brightman Manufacturing Company's catalog) shows the machine just described, except in matters of detail.

Design of Helical Springs for Safety Valves.

BY H. S. NACHMAN.

One of the most commonly used formulas for the design of springs is that given by C. Bach:

$$P = \frac{\pi}{8}\frac{d^3 s}{D} = .392\frac{d^3 s}{D}$$

in which

P = safe load,

d = diameter of wire,

D = diameter of spring (center to center of wire),

s = safe shearing strength of metal.

In a safety valve the load on the spring is that due to the pressure of the steam. Let p = steam pressure and v = diameter of valve.

Then $$P = \frac{\pi V^2}{4} p,$$

or equating the two values of P

$$\frac{\pi V^2}{4} p = .392\frac{d^3 s}{D}$$

Let us assume a ratio of $\frac{D}{d} = 6$, which gives about the proper value for the diameter of springs for this purpose.

Then $$\frac{\pi V^2}{4} p = .392\frac{d^3 s}{6d} = .392\frac{d^2 s}{6}$$

and $$d^2 = \frac{6\pi V^2 p}{4 \times .392 s} = 12.015\frac{V^2 p}{s}$$

Taking the value of s for steel equal to 30,000 pounds per square inch, we have:

$$d^2 = \frac{12.015}{30{,}000} p V^2$$

or $$d = \sqrt{.0004 p V^2} = .02\sqrt{p}\, V$$

If this equation be plotted on co-ordinate paper, it will give a straight line for each value of p. This has been done in the diagram, the valve diameters being taken as abscissæ and wire diameters as ordinates.

For square wire the formula is:

$$P = \frac{4}{9}\frac{b^3 s}{D} = \frac{\pi V^2}{4} p$$

$$\frac{4 b^3 s}{54 b} = \frac{\pi V^2}{4} p$$

$$b = \sqrt{.00035 p}\, V = .018\sqrt{p}\, V$$

in which b = side of square wire.

This equation may be plotted in the same manner as the previous one, or the diameter for round wire may be found from the diagram and then multiplied by a coefficient $c = \frac{.018}{.020} = .9$.

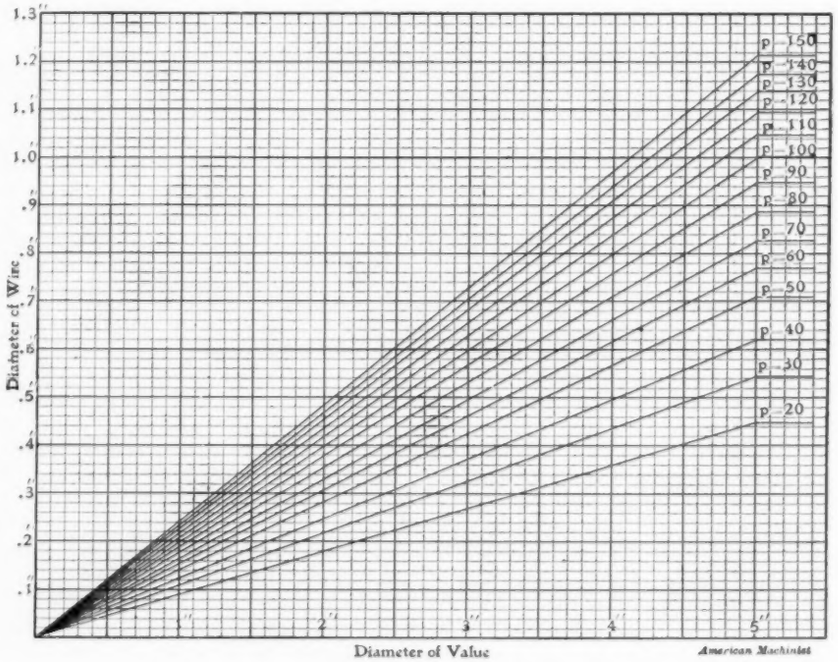


DIAGRAM FOR SAFETY VALVE SPRINGS.

Welding Iron and Steel With the Blowpipe.

United States Consul Marshal Halstead writes, quoting the *Birmingham Daily Mail* for his authority, that there is now on view in Birmingham an invention for the seamless welding of iron, steel and other metals by heat produced by the burning of acetylene with oxygen. With a special blowpipe and the mixture mentioned the welding of iron and steel, etc., is done in the same way "as a plumber deals with lead." The acetylene is supplied in cylinders in a state of absorption by acetone, which has the property of dissolving ten volumes of the former for each atmospheric pressure, thus obviating all danger that has hitherto existed in the compression and storage of acetylene. It is stated that the process has been sanctioned by the Home Office after exhaustive experiments. The separate gases are passed through valves, which reduce the initial pressure in the cylinders to about 7 pounds per square inch on the blow-pipe. The acetylene when ignited produces an intensely luminous glare, which vividness disappears when mixed with oxygen, there remaining a small, greenish-blue flame which is adjusted to the proper dimensions for producing the greatest amount of heat. The heat zone is practically only about one-eighth of an inch in length, but the temperature is so great that after a very short space of time the metal, wherever it comes in contact therewith, is reduced to a molten state and coalescence follows. Even quartz, it is stated, can be melted as quickly and blown like glass. The representatives of the *Mail* saw several pieces of work done, including the welding, instead of riveting, of a sheet of metal intended to form the body of a foot warmer for railway cars—the joining of two pieces of metal which when rolled out cold into half thickness gave not the slightest indication of a joint. In order to test the strength of joints experiments with compressed gas cylinders have been made; these, about 6 inches in diameter, with longitudinal and circumferential seams at the ends and also a boss welded in the center, withstood a pressure of 2,000 pounds to the square inch. Although the heat produced by the fusion of acetylene and oxygen is so great, operations can be performed with the naked eye. The patentees claim that the invention will be useful in making the construction of framework in the cycle trade stronger, while the apparatus might also be used in filling up corroded places or patching steam boilers.

Germany Studying American Methods.

The following is from the annual report of H. W. Harris, United States Consul at Mannheim, Germany:

A query frequently raised by the German press is how American manufacturers paying wages at least twice as high as are paid in Germany are able, in many cases, to produce their wares cheaper than they can be produced here. The solution of this question is certainly before the German manufacturer as never before. He sees that the cheaper raw material and boundless natural resources of the United States furnish only a partial answer, and that the real solution is to be found in a manufacturing system that rejects traditional methods—a system the keynote of which is to lessen the cost of production; that consigns a machine to the scrap pile as soon as a better one is to be had, and in turn consigns that one to the scrap pile when occasion demands—a system that offers a constant incentive to each man connected with the manufacturing plant to bring out the best that is in him. The advantages of such a system have been again and again referred to by the German press during the past year. It will undoubtedly be the standard toward which, in the future, the German manufacturer in all lines will strive. He has already accomplished much in this direction. How rapidly and to what extent he may further advance remains to be seen. He will have the advantages of a widely diffused technical training among the German people, the product of a flexible school system which readily adapts itself to the needs of manufacturing and commerce; workmen who specialize easily and who are patient in the mastery of details. *In some cases he will perhaps be hampered by the tendency of an academically trained class in a shop to discourage the advancement of those not so trained.* Whatever change of scope or method may occur in the future of German manufacturing, without question the United States will be the model whose methods will be chiefly studied and whose machinery will continue most in demand.

The International Association of Machinists, in an authorized address, counsels its members to act discreetly as to treating representatives of the Grand Lodge when they come to visit subordinate lodges. The address says that it is not fair to suppose that a man must drink whether he likes or not. The best way is to stop treating. It then goes on to say that the drink habit grows on people, and the safest way is to do away with the treating habit as much as possible.

A meeting of the American Society of Mechanical Engineers is announced for the evening of January 26 at the house of the society in this city. Mr. John A. Brashear, of Pittsburgh, is to read a paper upon "The Evolution of Measurements." It is expected that at least two more monthly meetings will be held this season.

We have received a copy of the first issue (January, 1904) of *The Iron and Steel Metallurgist and Metallographist*, the direct successor of *The Metallographist*. It quite completely covers the field indicated by its title. Published by Sauveur & Whiting, Boston.

The Work of the New York Metal Trades Association.

We have received a copy of the report of the commissioner of the New York Metal Trades Association for 1903. The report gives the details of the numerous controversies which the association has had with labor unions, including the demands made and the final terms of settlement. It also gives the text of such annual agreements, to the number of four, as the association has made with various unions and thus gives a compact account of the results achieved by its first year's work. The report concludes as follows:

"The open shop has been established and is maintained, the sympathetic strike and minimum wage have been eliminated, more amicable relations between employer and employee have been brought about, a more intelligent and honest appreciation of the obligations of a contract have been learned by workmen, and confidence has been established between the two parties to production, all of which portends highest good for manufacturer and workmen and for industrial welfare."

Our annual crop of calendars, many of them of attractive, artistic and original designs, but not here to be invidiously specified, has included the following: Cleveland Twist Drill Company, Cleveland, Ohio; F. E. Myers & Bro., Ashland, Ohio; John Rourke & Sons, Savannah, Ga.; Cleveland Pneumatic Tool Company, Cleveland, Ohio; Bullock Electric Manufacturing Company, Cincinnati, Ohio; Smooth-On Manufacturing Company, Jersey City, N. J.; American Steam Pump Company, Battle Creek, Mich.; Edwin R. Kent & Co., 10 South Canal street, Chicago; Whitman & Barnes Manufacturing Company, Chicago; H. B. Underwood & Co., Philadelphia; Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York; J. D. Smith Foundry Supply Company, Cleveland, Ohio; Springfield Machine Tool Company, Springfield, Ohio; Pope Manufacturing Company, Hartford, Conn.; Greer Clarkson Company, Manheim, Pa.; *The American Blacksmith*, Buffalo, N. Y.; The Philadelphia Bourse.

Standard railroad track will safely sustain from 225 to 300 pounds per car wheel for each yard-pound of rail.

The most valuable knife in the world is in the collection of a famous firm of cutlers in Sheffield. It contains seventy-five blades, which close up like those of an ordinary knife. Each of the larger blades is elaborately engraved, and among the subjects are views of Sheffield College, the city of York, Windsor Castle, Arundel Castle and a score of other famous scenes. The hafts are of mother-of-pearl, carved with great skill. When asked as to the value of this knife, the firm replied: "Well, we calculated it up to £920, but that was before it was finished."—*Answers.*

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The Organization of Sections in Engineering Societies.

This subject is again brought out by an editorial in our contemporary, *Engineering News* for January 14. There are, of course, two methods of sectionalizing societies of this kind—the geographical and the professional—and we have in this country examples of both. The most recent and noteworthy example of the first method is the American Institute of Electrical Engineers which has incorporated it in its constitution and which, in consequence, has made large gains in membership, as our readers have already been informed. According to our contemporary the Institute of Architects and the American Chemical Society are also organized on this plan. Of branch organizations on the lines of various specialties the Boston Society of Civil Engineers, which has recently adopted this plan of organization is an example, and the same is true of the Franklin Institute and the Engineers' Society of Western Pennsylvania. Of national engineering societies we have, in this country, none organized in this manner, but the American Association for the Advancement of Science may be taken as a typical illustration of the method as applied to pure rather than applied science, this organization having been copied from the older example of the British Association for the Advancement of Science. The British Institution of Civil Engineers, while not formally separated into sections, nevertheless embraces all branches of engineering and is thus far more representative of engineering than any society which we have. Of sections organized upon geographical lines we have also the highly successful example of the German Society of Engineers.

Of the advantages of both plans of organization there can be no question and of the organization of specialty sections not the least advantage is the simple economy of time at meetings. The chronic condition at the meetings of the American Society of Mechanical Engineers is lack of time for suitable discussion. This would be greatly helpful if authors of papers would forego the pleasure, to them, of boring their auditors by reading papers which are already in type and hence familiar to all who are interested in them, but we despair of seeing authors of papers adopt a different plan. The branch organization plan would, however, accomplish the same object by providing parallel sessions, each devoted to its own specialty, the members selecting those sessions for personal attendance which offer papers of most interest to them. The advantages of such a plan of conducting meetings are so well set forth by our contemporary that we can do no better than quote the concluding paragraphs of its article:

"The engineer who goes to the trouble to prepare a professional paper for presentation before a society, desires above all things to have it heard or read by men competent to understand and appreciate the ideas which he puts forth.

"We have frequently heard papers presented before engineering societies of national reputation, which represented weeks of toil and research on the part of the author, and yet the paper was received by the audience without the slightest token of interest and without a word of comment or discussion being offered.

"In contrast with this we have heard sharp and intelligent discussions in small organizations devoted to a special branch of work. Here the reader of a paper knew that the audience before him could understand every statement he made, and that there was no use in presenting platitudes or vague generalities. It is the papers read and the discussions engendered under such circumstances that make most largely for professional progress."

Microscopic Accidents.

Some recent decisions of the English courts seem to place a somewhat new and more comprehensive definition upon the word "accident." The decisions were rendered in connection with what is known as the Workman's Compensation Act, in which an employer is liable for accidents occurring to his workmen under certain conditions, and the decision is to the effect that the accidental entering of a bacillus into a workman's system constitutes an accident, the judge declaring that, for instance, the accidental entrance of a bacillus from wool infected with anthrax into the eye of a workman is in no way different from the accidental entrance of a spark from an anvil or the accidental squirting of scalding water or some poisonous liquid into the eye, except that in the former case the foreign and injurious substance is perceptible only by the aid of a microscope. It is thought that this decision will do much to improve the sanitary conditions under which English work people exist in many cases, making it necessary to introduce fans and to otherwise take precautions against the unnecessary infection of the atmosphere in which people work.

Additional Equipment of the Engineering Department of the University of Illinois.

The State of Illinois has appropriated $150,000 for the equipment of the College of Engineering of the University of Illinois, of which $30,000 is to be reserved to extend the present equipment for the use of undergraduate students and the remainder will be used to establish an engineering experiment station. The first portion of the fund will be expended in the erection of a foundry and of a steam engineering laboratory, but the second portion will not be used for the erection of buildings, the equipment of the experiment station being distributed among the laboratories of the different departments.

Some New Things.

A NEW AIR COMPRESSOR VALVE GEAR.

We illustrate herewith the interesting valve gear of the air cylinders of an air compressor which is to be installed at the St. Louis World's Fair by the Laidlaw-Dunn-Gordon branch of the International Steam Pump Company, Cincinnati, Ohio. The machine is to have 13- and 24-inch steam cylinders and 22- and 14-inch air cylinders with a stroke of 24 inches. Fig. 1 gives a cross-section of the air cylinder, and Fig. 2 shows the valves in greater detail.

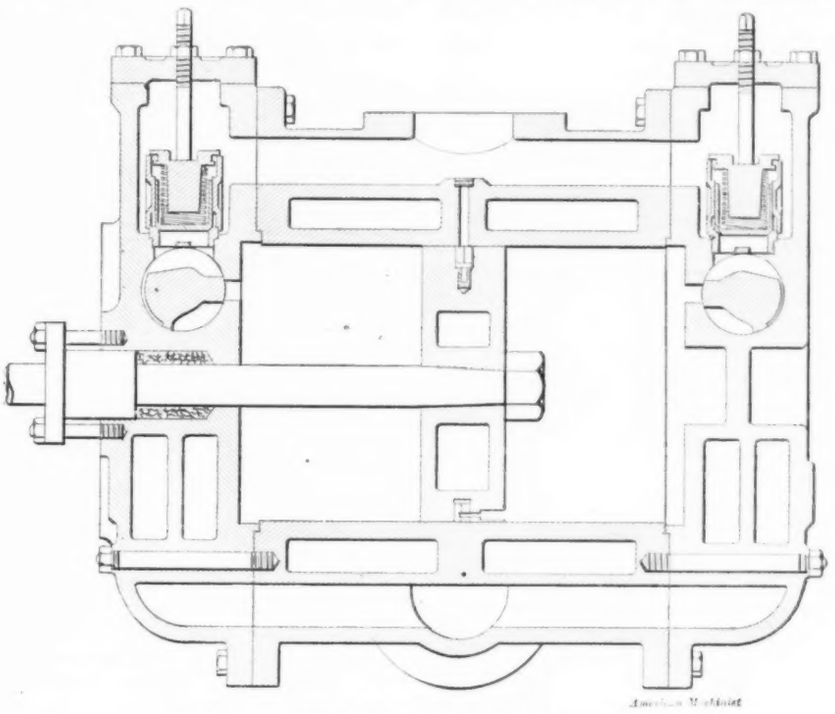


FIG. 1. SECTION OF AIR COMPRESSOR CYLINDER.

The oscillating Corliss valve acts to both open and close the admission and to close the discharge, the opening of the discharge being controlled by the poppet valve above the Corliss valve. The incoming air arrives by the passage *a*, Fig. 2, this passage being placed in communication with the port *b* by the Corliss valve shortly after the beginning of the suction stroke—that is, at the point where the compressed air in the clearance spaces has re-expanded down to the atmosphere. As the motion of the piston proceeds the valve continues to open by turning in the direction indicated by the arrow *c* until the middle of the stroke is reached, when it reverses its motion and gradually closes the port by moving in the direction of arrow *d*. As the center is passed and the compression stroke begins the motion in the direction of arrow *d* continues and the port is placed in communication with the space *e*, the compressed air in *f* being held back by the poppet valve. When the cylinder pressure reaches that in the receiver the poppet valve opens and the air is discharged. When, however, the center is turned the Corliss valve closes the port, trapping compressed air in space *e*, this air acting as a cushion to check the closing of the poppet valve and prevent its violent slamming against its seat, especially at high speed. The port being closed to the discharge by the Corliss valve, it is a matter of indifference when the poppet valve closes, provided it is some time during the succeeding suction stroke, and the poppet valve may therefore obviously be provided with a very light spring.

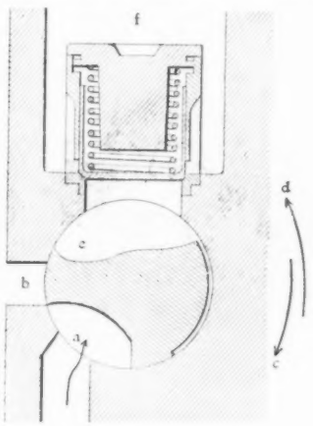
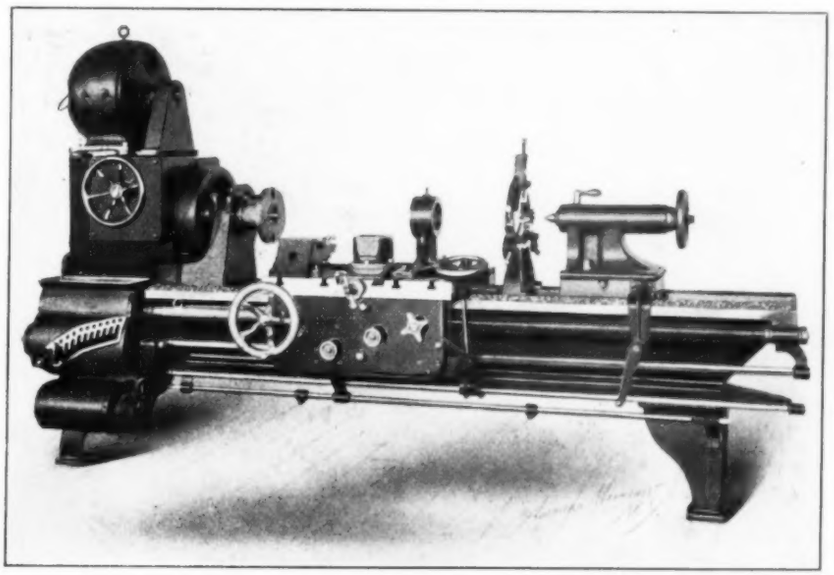


FIG. 2. ACTION OF VALVES.

24-INCH LATHE WITH MOTOR DRIVE.

This tool is the well-known Hendey-Norton lathe equipped with a Crocker-Wheeler 5 horse-power, low-speed, shunt-wound motor which is supplied with current on the multiple-voltage system through a 21-point controller. A Morse chain transmits power from the motor to a sprocket which may be connected to the spindle directly or through either of two back-gear combinations. The first combination gives a reduction in speed of 1 : 2.68, and through the second a further reduction in speed of 1 : 2.63 is obtainable. The highest speed of the motor is 1,270 turns per minute and the corresponding speeds of the spindle 285, 108 and 40.4 turns per minute. The upper twelve speeds of the motor when driving the spindle directly, the same on the first gear combination, and the upper eighteen on the second, constitute the tool's working speeds, forty-two in all. Obviously the motor may be run at slower speeds, but there is no occasion for this except with the slowest gear combination, where as low a speed as four rotations per minute of the spindle is possible. The controller is manipulated from a hand-wheel supported by the carriage, the connection being through gears and a splined shaft, so that the motor is under instant control of the operator at whatever position along the bed the carriage may happen to stand.



24-INCH LATHE WITH MOTOR DRIVE.

POSITIVE FEED FOR UPRIGHT DRILLS.

We illustrate herewith a new geared positive feed for upright drill presses which is the product of the W. F. & John Barnes Company, of Rockford, Ill.

Fig. 1 shows the driving head of the machine and Fig. 2 the train of feed gears. Referring to Fig. 2, the train of spur gears from the main driving shaft will be seen to give two rates of feed which are controlled by the hand lever at the right and which act to double the number of feeds obtained from the gears at the left. A pinion on the horizontal shaft may be adjusted to mesh with any one of the sets of teeth on the crown gear and thus give four changes. This adjustment is made by the lever at the left which has numbered notches to indicate its position and the rate of feed. The crown gear shaft is connected to the vertical feed shaft by spiral gears, as shown.

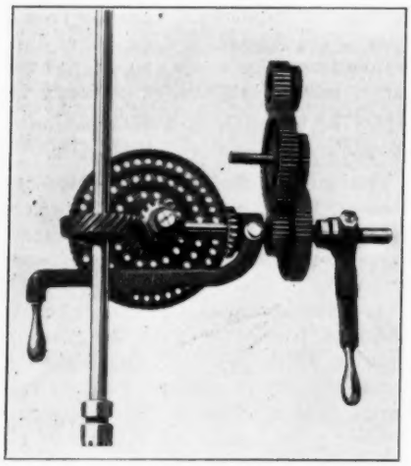
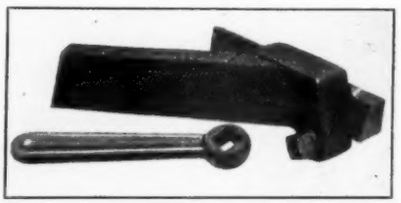


FIG. 2. MECHANISM OF THE FEED GEAR.

The gear is shown as applied to the larger sizes of machines. For the smaller sizes but four rates of feed are provided. The rates provided range from those suitable for drilling in steel to those suitable for boring in cast iron or for reaming.

SIDE TOOL.

The side-tool holder shown in the half-tone takes a blade of very stiff section, the stock tapering from top to bottom and being quite thick along the latter edge. The tool is beveled at the upper and lower edges to fit the dovetail seat in the holder, and is held securely by a flush binder bolt tightened by the nut at the side. The holder is drop-forged and case-hardened; the blade is of a special self-hardening steel. Though the tool holder shown is offset, straight holders also are made, and, like the offset type, both right and left hand.

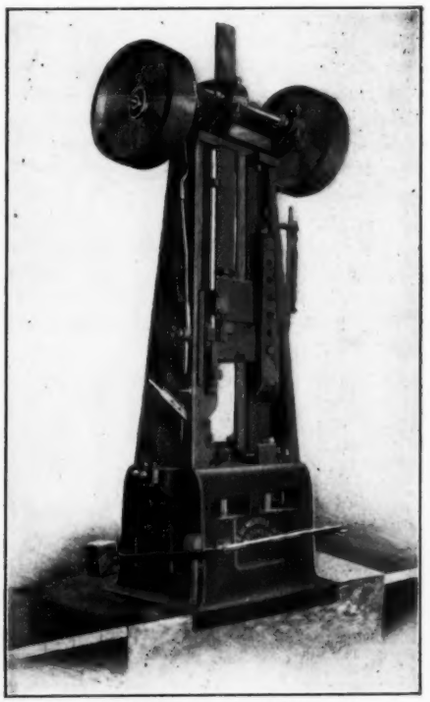


SIDE TOOL.

These tools are manufactured in various sizes by the Armstrong Bros. Tool Company, Chicago, Ill.

BOARD LIFT DROP HAMMER.

The friction board lift, poppet drop hammer shown by accompanying illustration, and furnished by E. W. Merrill, Jr., Brooklyn, N. Y., was designed for stamping high class bronze and sheet-steel building hardware, and to withstand the severe service of cold stamping. Attention is called to the massive proportions of all castings. The bottoms of the uprights resting upon the base of the 1,200-pound size hammer here shown measure 24 inches front to back. The total weight of machine is 28,000 pounds.



NEW BOARD DROP HAMMER.

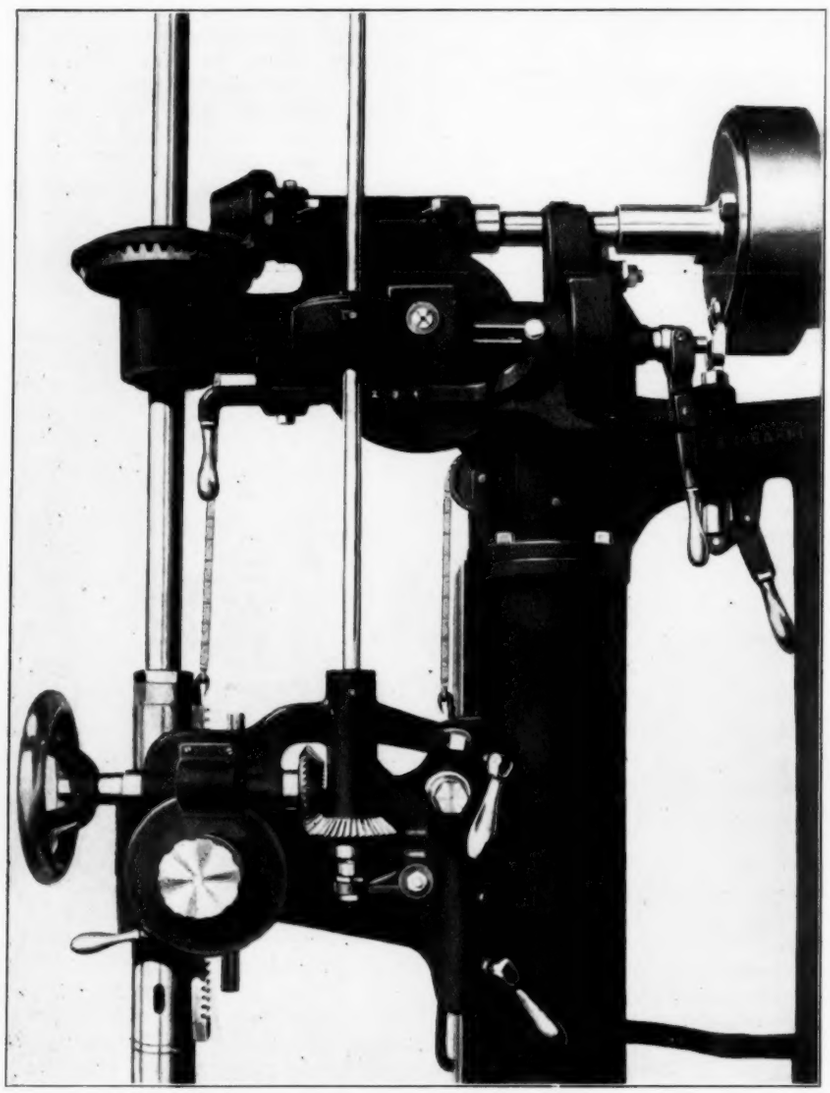
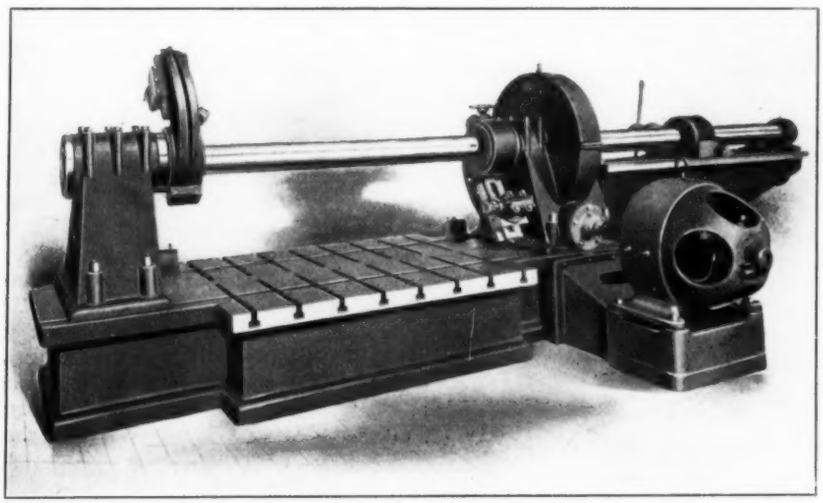


FIG. 1. GEARED FEED DRILLING MACHINE.

MOTOR-DRIVEN CYLINDER BORING MACHINE.

The tool shown in the accompanying half-tone will bore a cylinder and face the two ends at the same time, it being in

general design very similar to the belt-driven boring machine of the same builders, which tool we illustrated at page 556, Vol. 22. The driving cone of the earlier machine is here replaced by a Crocker-Wheeler 13 horse-power motor by means of which the spindle or boring bar may be driven—in either direction—at twelve rates



MOTOR DRIVEN CYLINDER BORING MACHINE.

of speed varying from 2 2-7 to 15 3-7 turns per minute. The bar itself, of hammered steel, is 6 inches diameter and 16 feet 8 inches long. It is rotated through Albro worm gearing, giving a ratio of 70 to 1, both worm and gear being encased in a single casting and arranged to run in an oil bath. The centers of the bearings in the pedestals for the boring bar are 24 inches from the bed. The bearings are bored 9 inches diameter and provided with sleeves which are feathered to the bar, but which while turning with the latter cannot move endwise in their pedestals. The upper of these two sleeves is 30½ inches and the lower 23 inches long; on an extension at its inner end each carries an arm with a facing block, which block may be fed radially with the facing tool or the latter moved in or out in its holder by star feed gear. For boring, a head, not shown, is attached to the bar and the latter fed automatically through rack and gear-driven pinion shaft at the head, or by hand through the pilot wheel in front, the continuous travel of the bar in either direction being 60 inches. The tool is built by the Meadville Vise Company, Meadville, Pa.

GERMAN PORTABLE ELECTRIC DRILLING MACHINE.

The portable drilling machines shown in the accompanying half-tones are the product of the Berlin Allgemeine-Elektricitäts-Ges. and are specially suitable for shipyards and similar works, and may drive the drill directly, as in Fig. 1, or through a flexible or articulated shaft, as in Fig. 2. The machinery comprises a direct or alternating current motor, with toothed gearing, built into a close cast-iron case. The covers of the motors are closed entirely so as to prevent foreign substances, rain, dust, etc., from entering the motor. The workmen cannot come in contact with either the current-conveying parts or with the gears. In the case of direct-current motors the shield on the side of the commutator is fitted with two covers, allowing of access to the brushes; in alternating current motors, this is not necessary. The motors are arranged for grease lubrication, and may work in any position. The drill frame is mounted on the gear case of the motor, the drill spindle being adjustable around the motor gear shaft. The drill spindle is driven through a pair of bevel gears. On account of the adjustability of the drilling frame, it is possible to drill in any desired direction, provided the machine be supported so as to stand the thrust of the drill. In boring vertical holes downwards, as is frequently the case in shipyards, the drill thrust is met by the weight of the machine itself as well as by the weight of the workman. The workman sits on a board slipped through the handles, whence he may operate the hand feed wheel as well as the switch of the motor. The weight of the machine is sufficient for drilling holes up to 23 millimeters in diameter. When drilling holes from 23 to 32 millimeters in diameter, the machine should be weighted.

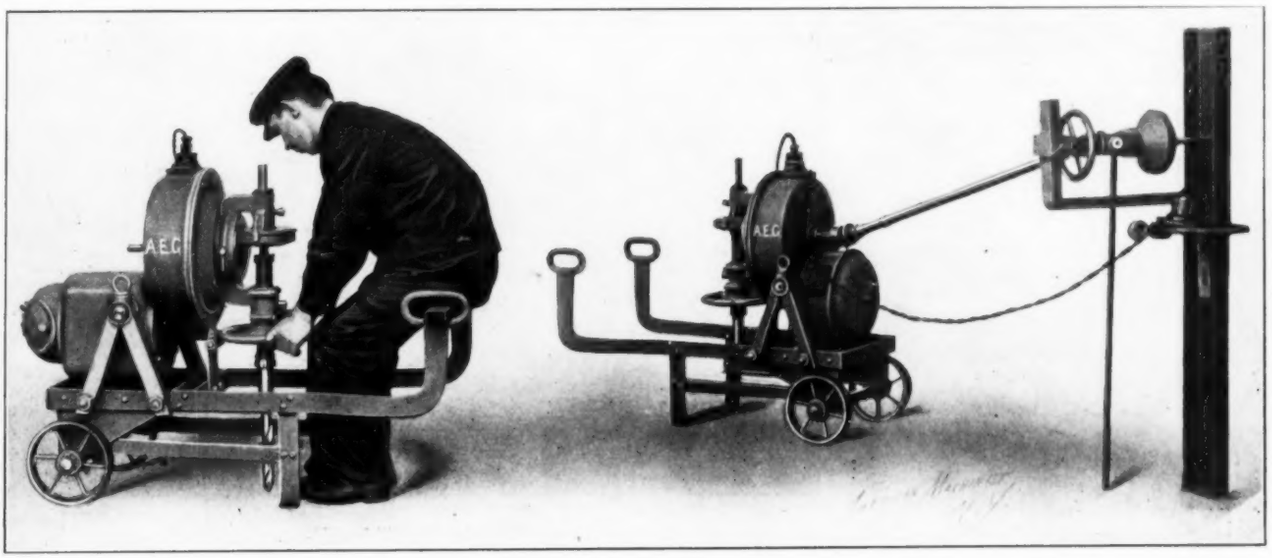


FIG. 1. FIG. 2.

A GERMAN PORTABLE ELECTRIC DRILLING MACHINE.

MULTIPLE VOLTAGE ELECTRIC GENERATOR.

Mr. G. H. Gibson, of 114 Liberty street, this city, is the inventor of an electric generator for use in connection with the multiple voltage system of power distribution and in which the various voltages are obtained directly from the generator instead of being split up by a separate machine. By means of two windings on the armature and two commutators in combination

with two balancing coils he obtains six different voltages which may have almost any desired relationship with each other.

WET CUTTER GRINDER.

This machine is built for grinding gear and other form cutters, hobs, taps, forming tools, etc., and to preclude all possibility of cutting edges being overheated during the sharpening operation, provision is

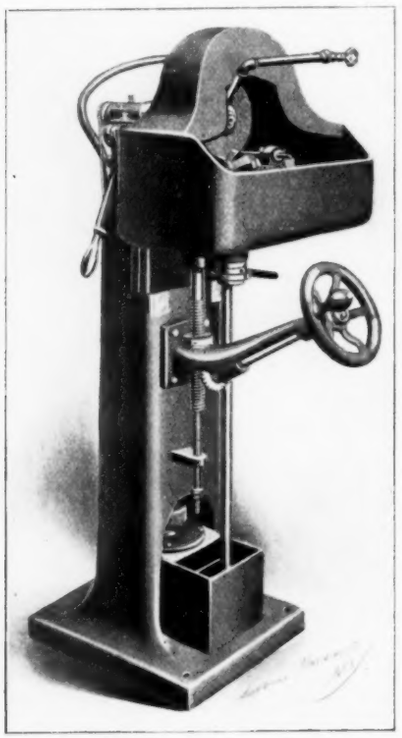


FIG. 1. WET CUTTER GRINDER.

made for doing the grinding under a liberal supply of water. The machine consists, as shown in Fig. 1, of a base and column with a head for the wheel spindle at the top, this head having both longitudinal and lateral movements in its guide

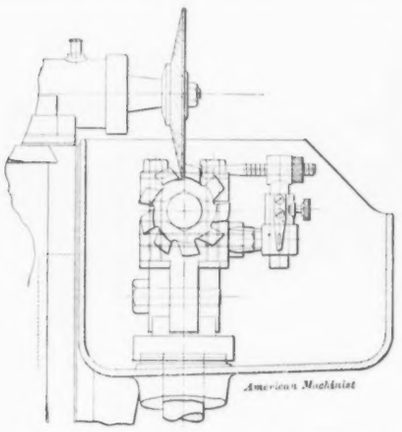


FIG. 2. SHOWING METHOD OF HOLDING CUTTER.

on the column. The work is carried by a universal holder which is suitable for straight and taper arbors, straight or angular cutters, flat forming tools, chasers, etc.; the holder is located in the vertically adjustable trough under the wheel, and the latter is passed back and forth across the

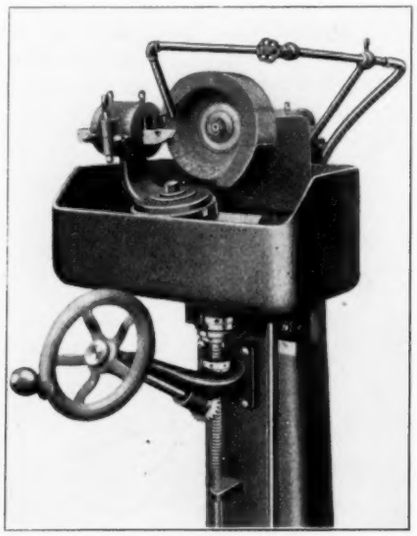
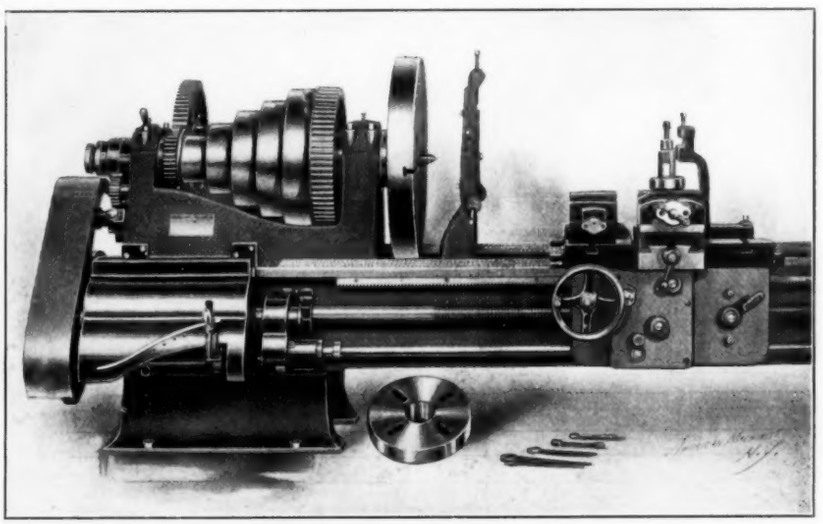


FIG. 3. ATTACHMENT FOR GRINDING LATHE AND PLANER TOOLS.

work by means of the lever depending at the side. The work holder, with a cutter in position on an arbor, is shown in the sectional view Fig. 2, and it will be noticed that the tooth rest strikes the back of each tooth as its face is presented to the wheel. Say one is sharpening a new gear cutter which has been doing most of its work with two or three high teeth: These teeth naturally show the greatest wear; and after the grinder head has been adjusted to bring the face of the wheel in the radial plane, and the cutter has been set to hight by the hand-wheel in front, the faces of the high teeth and also of the others may be ground back independently of one another until their extremities are equidistant from the center. This of course results in the teeth being of different thicknesses from face to heel, and to bring them all alike in this respect the faces are brought one after another against the tooth rest and the rear faces ground, thus establishing accurate gaging points by which the cutter may at all times be accurately and correctly ground. For grinding lathe and planer tools to standard angles and proper clearance, the attachment illustrated in Fig. 3 is furnished. This consists of a swiveling casting carrying a chuck for the tool, which chuck may be rotated in its bearing, and like the swivel support, set at any angle desired. When this attachment is in use, the thin cutter sharpening wheel is replaced by the cup wheel shown. The water for keeping the work cool is supplied from a tank at the bottom of the column by a centrifugal pump, and efficient guards are provided to prevent the liquid from splashing over the machine. The grinder is furnished with equipment for cutter and form tool grinding alone; with the extra attachment for lathe and planer tool grinding; or with the latter equipment only. It is made by the Heald Machine Company, Worcester, Mass.

32-INCH ENGINE LATHE.

The chief feature of interest in this lathe is the feed gear under the head, by means of which gear forty-eight rates of feed for either screw cutting or turning may be obtained. The lead screw and the feed rod terminate, as will be noticed, at the end of the gear box; but through the medium of a sliding gear either may be connected with and driven by the bank of gears in the box. A tumbler gear connects the shaft, which receives the power from the lathe spindle to any one of the gears in the cone, this tumbler being shifted to the necessary position for any pitch by means of the handle in front, which has, as indicated, twelve different positions. Further, there are four gear changes made at the end of the head, and these give, in combination with the twelve in the case, the forty-eight changes of



32-INCH ENGINE LATHE.

feed. The apron is double, and carries a device which makes it impossible to engage both screw and rod at the same time. The spindle bearings are 5½x8¾ inches and 4x6 11-16 inches; the hole through the spindle is 2½ inches diameter. The nose is 4¼ inches diameter; the largest step is 21 inches diameter, and the back gear ratio 14 to 1. Prentice Bros. Company, Worcester, Mass., are the builders of this lathe.

Personal.

Ellis C. Spoker, the expert in cement plants, has become associated with the Engineering Company of America, with headquarters at their Chicago office.

H. C. Williamson has taken charge of the Pittsburgh branch store of the Walter H. Foster Company. Mr. Williamson has been until recently located in New York.

H. M. Deavitt, analytical and consulting chemist and assayer in Chicago, has taken the management of the Chicago office of the Engineering Company of America, 159 LaSalle street.

Herman Jonson, a sometime contributor to our columns, has associated himself with the Acorn Engineering & Manufacturing Company, of New York city, in charge of shop operations.

O. H. Reynolds has joined the editorial staff of *The Railway and Engineering Review*, of Chicago. He will be the Eastern editorial representative, with headquarters at 140 Nassau street, New York city.

Edward Everett, civil engineer who has specialized in railroad work, and who made the survey for one of the Hudson River tunnels, has become associated with the Engineering Company of America's New York office, 74 Broadway.

F. Herbert Smith, who has for the past year acted as president and general manager of the Etna Manufacturing Company, resigned on December 31, 1903. R. F. Manning has been elected president and general manager in place of Mr. Smith.

Our contributor, Joseph V. Woodworth, has opened an office at 57 Tompkins avenue, Brooklyn, N. Y., where he proposes to carry on a consulting business, particularly with reference to punch and die work and methods of manufacturing articles by punching and drawing-press methods.

The friends of Chas. A. Francis will be glad to know that he arrived at his destination, account of which was given at page 1446, Vol. 26, after a very pleasant trip of eighteen days from San Francisco. Arriving at Tokyo November 3, Mr. Francis was tendered a welcome reception on December 16 by the professors of the Tokyo Koto Kogyo Sakko at the Sei-Yo-Ken, Wyena Park, Tokyo.

Obituary.

Theodore D. Kline, recently promoted to be general manager of the Central Railroad of Georgia, died in Savannah, Ga., January 10. At the age of fifteen he began work in the machinery department of the Charlotte & South Carolina Railroad and became master mechanic of its successor, the Charlotte, Columbia & Augusta Railroad, after that being successively connected with several other roads.

Charles Raymond, a sewing machine inventor and manufacturer, died at Guelph, Canada, January 4, seventy-eight years old. Mr. Raymond was a native of Massachusetts, and in the late fifties he invented and began the manufacture of the chain stitch machine known as the Nettleton & Raymond. There were four patents on the machine, but it was crowded out of the market by the combination and Mr. Raymond then began the manufacture in Canada, first in Montreal and later at Guelph, where a flourishing business was built up more by foreign than by local trade. Mr. Raymond retired in 1894, leaving the business in the hands of a limited liability company.

Commercial Review.

NEW YORK, Monday, Jan. 18, 1904.

Enough of the new year has passed to admit of some definite reference to the developments it has brought forth in the machinery trade. Interviews with many houses, embracing nearly every department of the trade, would indicate that business has shown a distinct improvement over December. There are some houses which do not see any appreciable difference so far from the standpoint of orders, but even among these, as well as among those whose orders have increased in volume, by comparison with the period mentioned, assurances are given that the machinery situation at present, especially so far as the outlook goes, is better than it was several weeks ago.

Machinery men find cause for congratulation in the unmistakable evidence the last few weeks have given, of many propositions that have been lying dormant for some time—some of them as far back as last spring—showing some signs of life. A representative of one of the leading machine-tool houses speaks of having heard from a railroad and electrical machine-tool proposition, which has been for a long time withheld. An engine manufacturer tells us of a large order for power equipment which he has been after for nearly six months, and which is now being taken up with a view to closing. As to inquiries, it can be said that they are beginning to come in a little more frequently, and one of our informants declares they are largely made up of those which hold out excellent hopes for resulting business. So taking things all in all, the feeling in the machinery trade at this writing, is more satisfactory than could be recorded a few weeks ago.

There are some sources of trade which have been quite barren for several months past, but which are slowly but surely beginning to look more promising. One of these is the cement industry, the notable recession in which we made the basis of extended reference not long ago. The fact that the building trade is weekly showing evidence of revival, with the outlook for continued improvement excellent, has not only led to the overhauling of old plants, but to the contemplated construction of new ones. It cannot be said that the orders which have made their appearance from these sources so far are of any consequence, but to the machinery merchant there is no information more pleasing than that which relates to the disappearance of obstacles which have stood in the way of him receiving some orders. "It's hard enough to find out where there is a possibility of trade," said a machinery man, "but when you do so and are then told that this or that is in the way of getting the order, you can never rest easy until you or someone else gets it. For that reason the animation some dormant machinery propositions have shown recently, is very gratifying."

"In this connection," continued the speaker, "you can form but a slight idea of the great expense machinery houses were put to during 1903, trying to close orders which were held back for some reason or another, and of which the year was most prolific. Many a house thought a little prodding would do some good, and sent its representative to do it. But the old stereotyped phrase 'not ready to do anything in that matter just now,' like Banquo's ghost, 'wouldn't down.' As a result expense accounts rolled up greatly, and many a machinery house's profits for 1903 would have been considerably larger but for the experiences I have mentioned."

Several weeks ago allusion was made in this column to the claim that many small manufacturers of cranes were quoting prices that were greatly at variance with those specified by leading concerns in the trade. It was also said that some manufacturers would like to see an association of crane builders formed, and that the National Machine Tool Builders' Association was suggested as a model. One of the best known crane manufacturing houses has favored us with its views on the article. They are as follows:

"It is a more difficult matter to agree on a price program in the crane business than it is in the machine-tool business. Machine tools are, in a measure, standard articles. Cranes are scarcely ever standard, but are made to fit the building in which they are to be placed. The thing which would be the greatest benefit to all crane builders would be an agreement in reference to safety factor so that all builders could be figuring on the same factor of safety. Our attention was recently called to a specification of a small crane where one bidder had specified two 10-inch I-beams for the bridge while our specifications called for two 15-inch I-beams. It is not surprising that our prices are higher

under these circumstances. Some education on what to include in the item of operating expenses would also be beneficial to the business in general. There has been a tendency on the part of some of the older and larger crane builders to accuse the newer and smaller concerns of price cutting. There may be some truth in this, but practically the only reliable evidence which we can secure on this subject is a comparison of published bids on government cranes, and a reference to bids on one lot of standard electric cranes, for the Portsmouth Navy Yard recently, will show that it was the older and larger crane builders, and not the newer and smaller concerns who did the price cutting in that instance, and we believe this is equally true on all recent private contracts."

We asked a well-known crane manufacturer what he thought of our correspondent's suggestion as to the propriety of an agreement as to safety factor. He replied:

"The suggestion is a good one, but what are you going to do about it? Manufacturers who read it will say it is all right. Every one of them, however, will probably ask himself how it is going to be made a uniform practice. Some manufacturer might send a letter to everybody in the trade urging its adoption, but I don't think any manufacturer will. The only way any suggestion of interest to crane manufacturers can be made effective, is by organizing themselves into an association, like the machine tool builders have done. Until crane builders have done this, they can expect the trade to continue as it is now, without uniformity of any kind existing as to construction or price."

President William Lodge, of the National Machine Tool Builders' Association, who was in this city recently in attendance at the meeting of lathe manufacturers—at which even more stringent measures to maintain present prices were taken than those previously in existence—reports machine-tool men in Cincinnati as finding trade improving.

The Lunkenheimer Company, Cincinnati, makers of brass and iron steam specialties report that owing to the unprecedented and growing demand for their specialties they have again greatly increased their facilities and are now in position to guarantee reasonably prompt shipments. They also report through their foreign branches an increasing export demand for their specialties and inform us that they will shortly place some new specialties upon the market, which will be contained in a very complete catalog to be issued in the course of a few months.

The S. Obermayer Company, manufacturers of foundry supplies, with general offices at Cincinnati, Ohio, shipped during 1903, 4,410 full carloads of their specialties, which weighed 160,352,000 pounds, and comprised 80,291 tons. The shipments if made at one time would make up a train forty miles long.

Mr. Arthur A. Fowler has been admitted into the well-known pig-iron firm of Rogers, Brown & Co., at 71 Broadway, this city, and will have his office there.

Bids for the construction of two 13,000-ton battleships, to be called the "Idaho" and the "Mississippi," were opened at the Navy Department, Washington, on last Friday. The Cramp Shipbuilding Company, of Philadelphia, was the only bidder for two vessels, the bid being $2,999,500 for each, one to be completed in thirty-eight months and one in forty months. For one vessel the Cramps' bid was $3,200,000, to be completed in thirty-nine months. When the Secretary of the Navy and the Board of Construction went over the bids they decided to award the contract for both battleships to the Cramps, at a total cost of $5,999,000.

The Newport News Company was the lowest bidder for a single vessel, the figures being $3,147,000, to be completed in thirty-seven months. The other bids were as follows: Maryland Steel Company, Baltimore, $3,472,000, to be completed in forty-two months; Fore River Ship Company, Weymouth, Mass., $3,468,000, to be completed in forty-two months, and the New York Shipbuilding Company, Camden, N. J., $3,500,000, to be completed in forty-two months.

Officers were elected on last Thursday at the annual meeting of the New York Metal Trades Association, at 203 Broadway, as follows: President, W. F. Palmer, of the Quintard Iron Works; vice-president, Charles L. Seabury, of Charles L. Seabury & Co. and the Gas Engine and Power Company; treasurer, M. K. Bowman, of the James Riley Repair & Supply Company; secretary, H. C. Hunter, 203 Broadway; executive committee, Wallace Downey, Andrew Fletcher, Jr., H. N. Covell, Christopher Cunningham, and Robert S. Wyatt.

CHICAGO MACHINERY MARKET.

As a general proposition, the demand for machinists' supplies is more active than that for machine tools, especially those which go principally to large and modern shops. This statement is made by a prominent manufacturer's representative, who sells both tools and supplies. The three or four large machinists' supply houses in this city are a unit in reporting that trade for the first two weeks of January is satisfactory, that it is larger than that of November or December, and that its comparison with January last year shows little if any loss. But when statements are gathered from factors of the trade that run more to specialties or to only one department of the general trade, there is variability to the returns. Perhaps it is a fair statement of the situation to say that shop activities are generally normal, but that there is hesitation in the placing of contracts for future requirements. The activity of shops is not universal. Many of the jobbing machine shops at Chicago are running only moderately well, and from some of them comes the report that while orders are as numerous as usual, they are generally for small amounts of work.

One reason for the hesitation is the unsettled state of values. It applies to all kinds of specialties. For example, there is less than the usual trading in cotton buffs. Sooner or later prices it is believed will advance because of the rise in the values of cotton. Users are ready to close contracts for long periods of time at the old prices, but sellers either restrict sales to quick shipments or they have already advanced quotations. But the effect is to disarrange the usual channels and conditions of trade. And in some other lines the tendency of values is downward, in which instance it is the buyer who is diffident about closing.

Architects say the prospective business in building for the spring is not yet accurately defined, but that it promises well. Rents are advancing in residence districts, because the buildings are pretty generally occupied, and this is stimulating an interest in construction which will perhaps not be thoroughly defined until satisfactory costs and the harmonious attitude of labor are assured. In various other directions there is an inclination to hold off until the labor situation becomes clearer.

C. H. Besly & Co. have shipped this month Gardner grinders to Europe, Australia and Japan and to all parts of the United States. Mr. Besly states that rarely if ever have the shipments in two weeks been so diversified as for the first two weeks of January. California is sending in many orders for Helmet oil and other specialties.

Edwin R. Kent & Co. say the demand for tool steel for the first two weeks of January is gratifying. The trade coming from the railroad shops is particularly commended.

Quotations.

NEW YORK, Monday, Jan. 18, 1904.

New York prices for Northern and Southern irons for nearby delivery are, nominally, as follows:

Northern:	
No. 1 X	$15 25 @ $15 75
No. 2 X	14 75 @ 15 25
No. 2 plain	14 25 @ 14 75
Southern:	
No. 1 Foundry	14 00 @ 14 50
No. 2 Foundry	13 25 @ 13 75
No. 3 Foundry	12 75 @ 13 25
No. 4 Foundry	12 25 @ 12 75

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.40c. upward in carload lots. Soft steel bars, 1.45c. upward.

Tool Steel—Base sizes—Good standard quality, 6¾ @ 7c.; extra grades, 13c. and upward.

Machinery Steel — Base sizes — From store, 1.80c.

Cold Rolled Steel Shafting—2.65c. from store for base sizes.

Shaft Turning Machine.

BY H. ROBINSON.

The accompanying Fig. 1 shows a new semi-automatic double-head turning machine especially designed for taking a light, smooth finishing cut of a few thousandths simultaneously over both ends of a shaft shown in Fig. 2, but which is not recessed in the center until after the ends have been turned.

Fig. 1 shows the machine as in actual operation. The shaft to be turned *a* is inserted in the hollow spindle *b*, which is split in such a manner as to very readily compress by a slight turn of the driving pulley *c* fitting over it, as the shaft fits the hole in the spindle nicely without any play. A slight compression of the spindle for the length of 1 inch grips the shaft tightly, the spindle being held stationary while being compressed by the engagement of the pin *d*, which is raised out of the way when the piece is gripped by the spring *e*. The shaft being ready, the cutting operation is started by turning the pilot-wheel *f* to the left. The shaft of this pilot-wheel carries a small pinion engaging in a rack on the inside of the machine and a V-grooved pulley fastened to which is a wire cable *g*, the left-hand end of which is fastened to the left-hand sliding head *h*. When the pilot-wheel is turned to the left it moves the two sliding heads toward the center until the cutters nearly engage the ends of the shaft, when the two split feed nuts *i* engage the feed screw *j*. The movement of the sliding heads having automatically moved the belt-shifter by a connection not shown, the machine starts in motion, the heads are fed forward and the cutters shave a fine cut of a few thousandths from the outside of the shaft, the tools being lubricated by a stream of oil fed through the cutter holders.

The machine is driven from the countershaft by two belts, one of which drives the pulley *c* and the other pulley *k*, fastened on a short shaft journaled in bracket *l* and driving a pinion meshing with a large gear *m*, which is keyed to the end of the feed screw *j*. When the cutter heads have traveled sufficiently forward to have turned the shaft the required length, the knock-out studs *n* come in contact with the ends of the clutch-springs *o*, which are so arranged that a slight pressure will release the split nuts, which then open up immediately and simultaneously by the tension exerted on them by the springs fastened to their opposite ends, as shown in detail in Fig. 3. The split nuts being disengaged from the feed screw, the sliding heads are simultaneously and quickly moved backwards, by the tension of the wire cable and the weights *p* fastened to them, till they come against the end brackets *q*, when the long jaws *r* fastened to the brackets close up the split nuts *i* and permit the springs *o* to snap over them and hold them together. The sliding heads by their backward motion

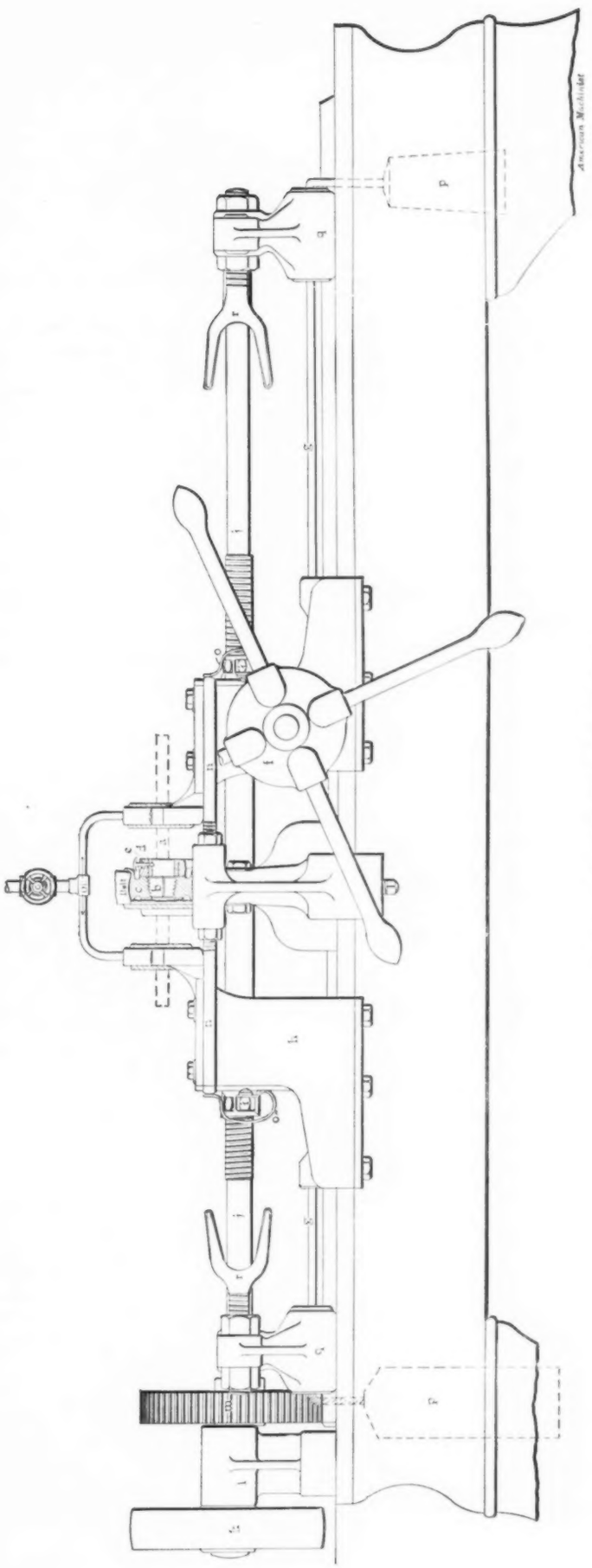


FIG. 1. SHAFT END TURNING MACHINE.

having acted on the belt-shifter to stop the machine, the shaft in the head of the machine is ready to be taken out and the operation repeated.

The cutter heads are of the adjustable die form, as shown in Fig. 3. The support *a* is split and, by removing the cap, the die may be removed for grinding and adjustment. The body *b* is cylindrical and without projections of any kind and, with the cutters in place, may be mounted in a grinder chuck for grinding the cutters which are then removed for backing off. The cutters have pins which enter cam grooves *c c c* in the knurled plates *d*—one on each side of the die head—and circumferential grooves *e e e* with binding screws secure the knurled plates in position. Two sets of cutters are used for roughing and finishing cuts, there being a hardened, ground and lapped steel bush *f* between them. Set-screws *g g g* bind the cutters. Oil hole *h* supplies the cutters with oil. In practice we found it best to give clearance to the roughing cutters only.

Fig. 4 shows the construction of the split feed nut and Fig. 5 shows more clearly than Fig. 1 the construction of the work-driving head.

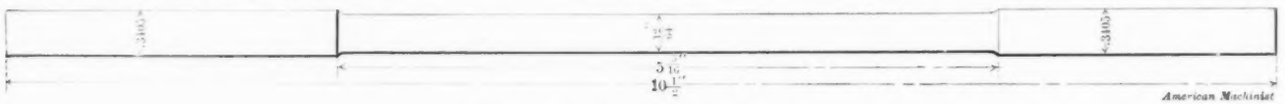


FIG. 2. THE SHAFT TO BE TURNED.

Echoes From the Oil Country—Relative Values—Reading Trade Papers.

BY W. OSBORNE.

There is nothing better than walking all around a subject if you wish to see all sides of it, and many people walking around will have more ideas than if only one did the walking. I think there are very few of us who try to hold our own in the mechanical world who have not walked around the question as to why there are so many that, to our way of seeing, would be benefitted by taking and reading their trade paper and yet who do not.

The editor, in "Those Who Subscribe and Those Who Do Not," advances the idea that we may be deceived as to the number of those who would really be benefitted. While he condenses a whole lot of truth into the paragraph where he tells what the paper will, and will not, do for a man, the general impression it left on me was that if a man has not the mental appetite and digestive powers for such things he should not be, by any mistaken idea of interest in his welfare, urged to make them a part of his regular diet. I think that we will all agree that any man is foolish to spend money for a thing that is of *no* use to him.

Perhaps there are some bad cases of mechanical dyspepsia that I am to blame for, as I have gone on the theory that it was good food for anyone working in a machine shop (of the jobbing and corn-sheller variety).

I find that Mr. Tecumseh Swift has been taking a stroll around this subject, and following his usual habit, has been "seeing things." Under the heading of "Mutual Attraction" he tells us that it is just what could be expected; that a man hunts around for the kind of company that he likes, and that the company is not surprised to have him find them. He intimates that the man with the hunger will buy what he wants if he does the marketing, but that there are those who are in the wrong kind of a boarding house. They eat what is put at them without thought that they might change.

A man who thinks in music and works in a machine shop because his father put him there is not likely, if left to his natural instincts, to take to a mental diet of the AMERICAN MACHINIST, for instance, unless it is to make the best of a bad bargain. At the same time he may never grasp the idea that he could make as good a living teaching music or playing in the band, and be doing that which he would like to do. While he might never buy a mechanical paper in the first instance, I do not think that there would be any lack of the musical literature he would accumulate.

While these two articles above referred to tell us why some people do and some do not take and read mechanical literature there is another class that I have seen in my stroll which they have not mentioned. How about the man that owns the shop and supplies the facilities? Perhaps he hasn't any taste for the mechanical work of the business, either; perhaps he buys his mechanical brains at so much a day; perhaps it is true that he would never read the paper if he did take it, as he has not the time to read half of what he now takes.

Perhaps, also, he would not buy a triplex hoist instead of his old differential blocks because he does not have to do the pulling; perhaps he does not furnish snap gages because the men furnish calipers of their own.

Does he reason this way when it comes to machinery and appliances? Many and many a man seems to be liberal in furnishing his shop with everything except ideas. The good workman will have his own, did you say? Yes, and the good man will ask for the high-speed steel, and hunt for the hardened mandrel that he knows runs true, and see that the drill is ground central for the close hole, and borrow the boss's micrometer for that close job. He didn't have much schooling, and never expects to be anything but a good workman, but he would not refuse to look in a paper

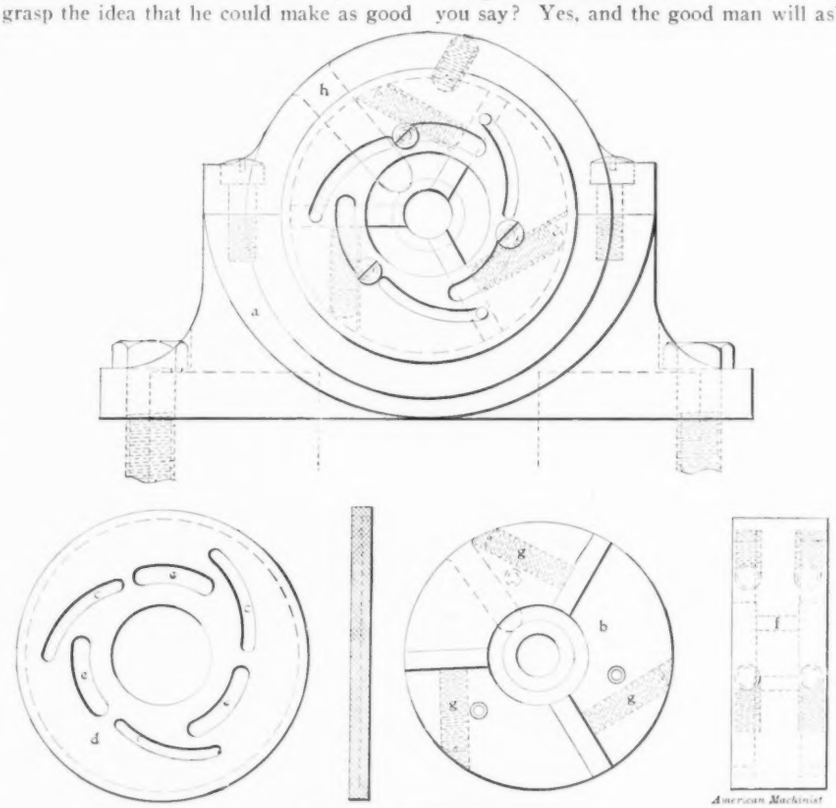


FIG. 3. THE CUTTER HEAD.

and follow another man's idea if it suited his work, any more than he would refuse to use any of the other things that were furnished.

Blank is a good close manager. He can see a dollar about as far as most men. He has no money to waste on the AMERICAN MACHINIST or any other such paper. He wants a paper that keeps him in touch with the metal market of course, but the daily papers do that. Don't you think that Blank would have a fit if he knew how much he was paying his latest addition in the shape of a designer for ideas that his own force could have found all ready for them if he had just taken the paper and put it where they could use it?

That new lathe cost several hundred dollars more than the old one that it replaced, because of being better and more convenient; with the best lathe hand in the shop on it there is a saving of nearly 25 per cent. A bound volume of the AMERICAN MACHINIST costs $5, and some of the diagrams that have appeared in it would save the draftsman several hundred per cent. if he had them at hand. One idea sent in by a contributor may cause a much greater saving in the shop than the new lathe.

While I must admit that there are men in the business who would not be benefitted their money's worth by taking the AMERICAN MACHINIST, I want a view from another side before I can admit that there are firms that run machine shops of which the same is true.

The small boy's essay said, "Whiskey has done some people a great deal of good by them not having anything to do with it," and I think that the AMERICAN MACHINIST is a very expensive paper to some business men because they *don't* take it.

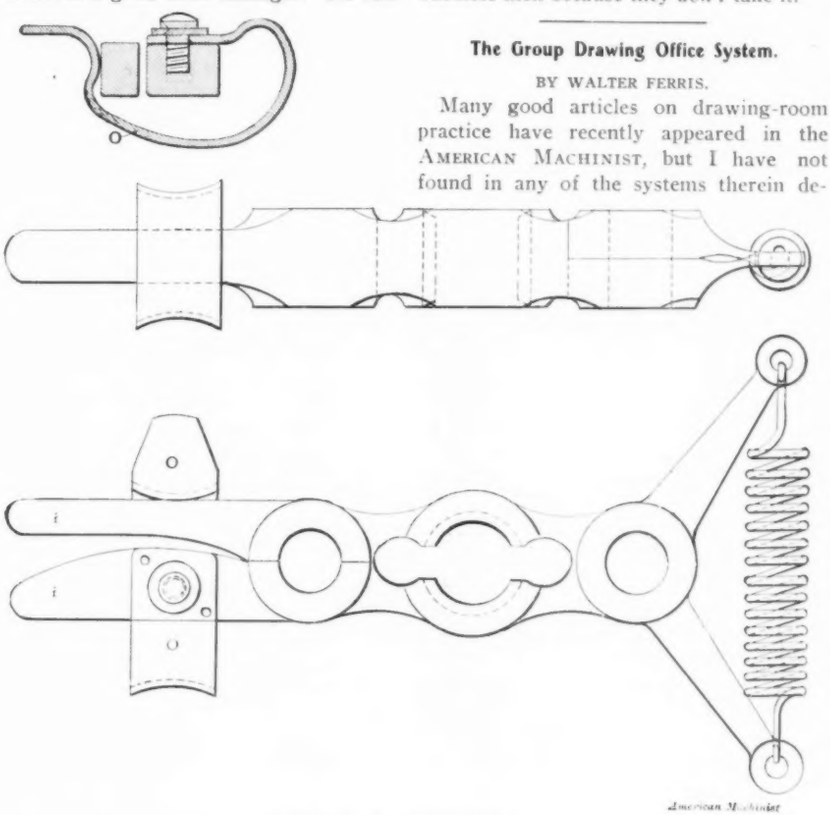


FIG. 4. SPLIT FEED NUT.

The Group Drawing Office System.

BY WALTER FERRIS.

Many good articles on drawing-room practice have recently appeared in the AMERICAN MACHINIST, but I have not found in any of the systems therein described a full solution of the problems presented in the engineering and drawing department of the Bucyrus Company, and doubtless also met with in any large establishment doing a class of work which must be standardized and built in large lots whenever possible, yet frequently changed in details to meet the special requirements of customers and improvements in design. In such work the problem of making plain instructions to the shop to build several large machines each week, some exact duplicates, others nearly duplicates, others largely special, in such a way that the orders shall be definite, the record clear and the labor involved moderate, is a very difficult one, and calls for the best thought which any concern has at its command.

The problem presents several aspects. Perhaps the most important, to an engineering establishment which lives and grows by the originality and soundness of its design work, is economy in draftsmen. This does not mean merely economy in draftsmen's time, represented by so many dollars on the pay roll. It means much more. The drawing room must be the source of information to the shop and to the purchasing department. When an important order is placed with the company, the first thing to be done is the design work. After the engineering offices have decided on the leading features of the design, generally as a result of conferences over the board of some leading draftsman, a leading draftsman is put in charge of the detailed working out of the plans. He makes the general layout, works out important details, and directs the work of the detail draftsmen. From this point on, he is directly responsible for the condition of this job. Patterns must be ordered as soon as their drawings are nearly finished, and often before other related drawings are ready to trace. Steel castings must be ordered as soon as the patterns are ready. Structural material must be ordered as soon as the dimensions are known—often while the structural drawings are only partly penciled. Thus, during months per-

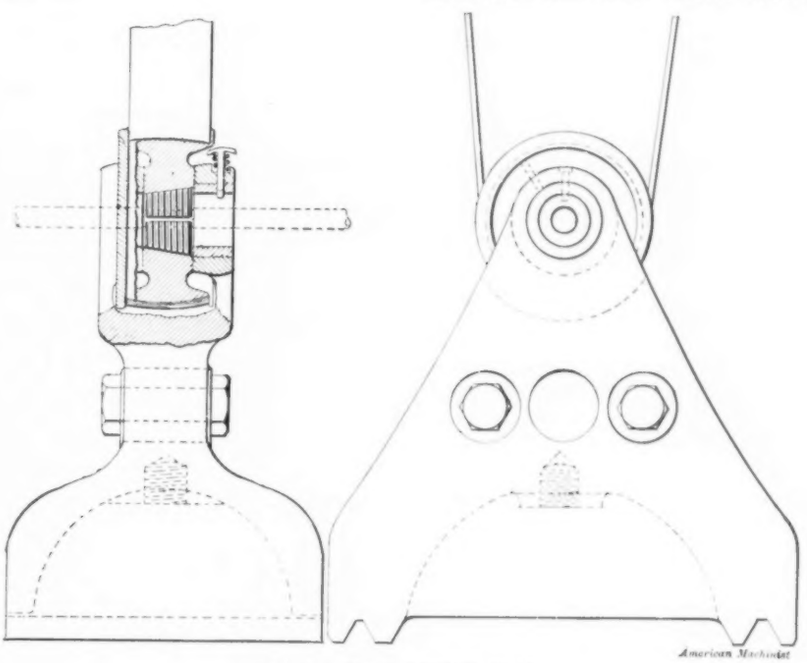


FIG. 5. WORK DRIVING HEAD.

haps, while it is impossible that there should be any complete set of drawings, this leading draftsman is the only man in the organization who can exactly know the condition of the order. He must carry the whole responsibility of enabling his employers to fulfill their promise of delivery, and a single omission on his part to instruct the purchasing department to order an essential part may result in weeks of delay.

Moreover, having begun to order the material before there was a complete set of drawings, he finally pushes the drawings to completion, and hopes to take up a new piece of designing work, for which he is employed. But not so; for now he is firmly established as chief clerk for the job that is supposed to be finished. He has notes showing when all the steel castings were ordered, and if any are missing, he must look over his records and find out why. This worries him, makes it impossible for him to do good design work, deprives the company of his best services as a designer and compels him to work as a clerk, for which he is much too highly paid. More important still, good designers are hard to find, and it is important that they shall be employed on their proper work, which no one else can do.

This is what I mean by economy in draftsmen, as distinguished from the loss of so many dollars' worth of draftsmen's time; for there are not many concerns that have more than a few good designers in their employ, and there is usually important work waiting for them, which does not get done unless a system can be devised which relieves them of unrelated work and enables the designer to hand over to another man the complete record of a job, when the design is finished, in concise and intelligible shape.

Let us clearly understand that this phase of the problem is due entirely to the necessity of issuing instructions to the shop. If the drawing room could confine itself to the economical production and filing of drawings, the difficulty would not exist, neither would it exist if the shop could wait for instructions until the drawing room had finished its work. This latter condition may perhaps be approximated in some establishments, but certainly not in any with which I have been connected. Hence it seems to me of prime importance that a system be employed which shall accomplish the following ends:

(1) Enable the drawing room to easily issue and record instructions in advance of completion of drawings.

(2) Keep the record in such shape that as soon as the drawings are complete, drawings and record of advance instructions may at once be handed over to the purchasing and manufacturing departments.

The next important side of the problem is the manner of issuing instructions to the shop. In any large shop a number of superintendents and foremen should all be supplied with duplicate instructions, fully describing the work to be done. These instructions must refer to drawings. Many of the drawings are used on various jobs, so that any special instructions on the face of the drawing are certain to cause errors and to necessitate changes in the drawings. Besides all this, when any error is discovered in the instruction sheets, the original must be corrected, and all the various copies in the hands of the foremen must either be corrected or replaced with correct copies.

Since entering the Bucyrus Company's drawing room, about two years ago, I have carefully observed the operation of the thorough system of issuing shop instructions already in use. By a rough estimate or guess, about one-third of the total amount of work done in the drawing room has been done either directly on the "order lists" (as we call them) or on the corrections and changes incident to the operation of the system. In addition to this, the system—though a thorough and apparently a good one—made it almost impossible to order material in advance of completion of drawings, or to issue to the shop one drawing of a set in advance of the remainder of the set.

These objections have led to various efforts to improve matters, which, however, have always been rather palliatives than sweeping changes. But a plan was finally arrived at which seemed to solve the difficulties. We have been gradually introducing it for about six months, and as the development has now reached a point where its success seems assured, I think it time to describe it in the AMERICAN MACHINIST, both in order to obtain helpful criticism and because I feel sure that a similar plan may be adopted in other shops to great advantage.

The vaults of the Bucyrus Company contain about 20,000 tracings, made during a period of perhaps twenty years. Of these about 4,000 are full size sheets (23x36 inches), and the remainder mostly quarter sheets (11½x18 inches) or eighth sheets (9x11½ inches). Of the full size sheets perhaps 1,500 are liable to be used on new work, while at least 8,000 of the small sizes are still "alive." It is evidently impossible to consider any system which does not provide for using these old drawings; and this is almost always the case in contemplating any change of drawing-room system in an old-established works. In addition, nearly all of the small drawings are on the "one piece per sheet" system, and all drawings are liable to be used on different machines at different times, so that they must not bear marks or notes that limit their use to any special machine or order.

As a preliminary condition to complete listing of the material, every part is given a piece mark. This consists of the drawing number on which the part is detailed, followed by a letter for a casting, or by a number if anything else than a casting. In marking a piece on its own drawing, the drawing number is not used except for the castings; thus, on drawing 12613, the forging 12613—1 is merely marked 1, usually enclosed by a freehand circle to prevent confusion with dimensions, but the casting 12613A is given its full designation, more from force of habit than anything else. There is, however, some reason in this, for the pattern number is really an individual name which never leaves that casting. If pattern 12613A is afterward slightly altered and redrawn on drawing No. 12672, it is called 12613AA. If again redrawn with alterations on drawing 13611, it is called 12613AB, and so on. In every case of change, the original tracing 12613 is taken out and an entry made on it, giving the drawing on which the latest alteration will be found. Thus the original drawing gives a complete history of the pattern, and its original name 12613A sticks to it through all vicissitudes. The other patterns 12613B, 12613C, etc., also have their changes entered on drawing 12613. For forgings, however, no record is kept, as it is not worth while (in our work) to be sure that the same forging or bolt shall not be called by different names at different times. There is nothing new in this piece marking, of course.

The problem is, in a shop building three steam shovels a week, besides dredges, pile drivers and wrecking cranes, to issue to the shops a detailed list of perhaps 2,000 parts for each machine or each lot of *absolutely* identical machines; to issue enough copies of this list to give a copy to each foreman; to be able at any day to issue a copy of the list in which 1,998 of the 2,000 items are identical with the last copy, but with two items changed to suit the requirements of a special contract; to do this without taking a large amount of drawing-room or even clerical work; and to do it so that the instructions are not ambiguous, or the history of the finished and delivered machines doubtful.

One result of our experience so far, in the effort to accomplish these things, is this conclusion: The blueprint is the only available means of issuing shop orders which begins to accomplish the results sought. There are two reasons for this: First, the blueprint contains *no errors*; if the original tracing is correct, all copies of it, sent to the purchasing department and to eight manufacturing departments will be correct and identical; second, the tracing may be used again and again, to make an unlimited number of prints, the matter written on the tracing being added to from time to time as hereafter described, but the old matter remaining clear and legible.

To issue lists of material from tracing cloth originals, it is evidently necessary that minor changes in the machines to be built shall not necessitate extensive rewriting of the tracing lists. This we ac-

complish by using the "group system" of listing material, as described by Mr. S. L. G. Knox at page 823, Vol. 24, in his article on the drawing-office system of the General Electric Company. As our adaptation of that system differs considerably from the original, and is intended to accomplish several results not included in the General Electric Company's scheme, I shall here refer only incidentally to that article.

The "group system" consists merely in having several vertical columns for number of pieces to be made in the printed blank for list of material. When the list is originally written, only one of these columns is used, and at the top of this column is written "G. 1" or "Gr. 1," meaning Group 1. When it is desired to build another machine nearly like the first, but with certain parts changed or omitted and new parts added, it is only necessary to fill in the second column, or Group 2, calling for the items already listed in Gr. 1 which are common to both machines, omitting to call for parts not used on the new machine, and writing in the additional parts for the new machine which were not used in the original machine. All this involves very little draftsman's labor beyond the actual drawing of the new parts. In many cases almost all of the old list applies, and only two or three new items are required. A very important incidental advantage arises from having the lists of the old and new machines on the same sheet or sheets, as the nature and extent of the changes are evident by a glance down the two parallel columns. In the group system, if the drawing showing a certain machine is No. 6823, the shop is ordered in the first instance to build

Drawn by H. Peake
Traced by H. G. P.
Checked by L. Wehner
Approved by W. S.
Refer to Dwg's Nos. 5031-28-29

THE BUCYRUS CO. No. 6660
5ft. ELEVATOR DREDGES No. 143-4 FOR 60 ft. DEPTH.
LADDER HOIST MACHINERY
First drawn for
Scale ½" = 1'-0" Date Oct. 21, 1903

List No. 6660 | Order No. 20136 | G. No. 1

Dwg. No. 6660 No. of List Sections. 2 Sect. No. 1

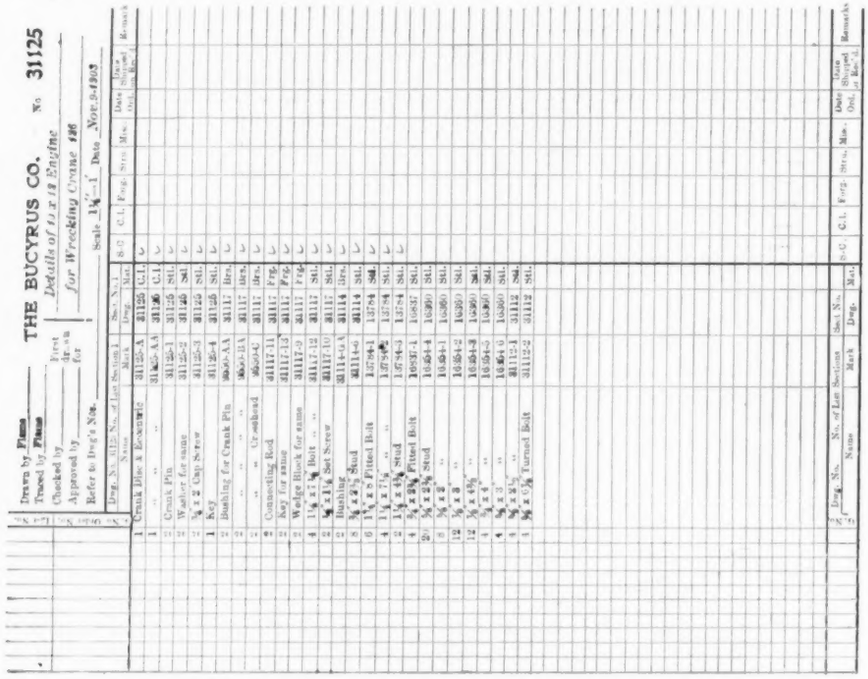
		NAME	MARK	DWG.	MAT.	S-C	C. I.	FORG.	STRUCT	MISC.	DATE ORDERED	DATE SHIPPED OR REC'D	REM.
1	1	Gear 70T 2½" P 7" F 7" bore	10423 AB	15551	S. C.								
1	1	Pinion 17T·· Shrouded	10422 AB	15548	··								
1	1	Cut gear 80T. 1⅝ P.	15454 A	15454	··								
1	1	Cut pinion 21T. 1⅝ P	15455 A	15455	··								
2	2	Bearings 5" bore	12807 AC	12969	C. I.								
2	2	Caps for same	·· BB	··	··								
2	2	Bearings 4⅝" bore	12823 AD	12901	··								
2	2	Caps for same	·· BA	··	··								
3	3	Bearings 4⅝" bore	995 AE	12810	··								
3	3	Caps for same	·· BE	··	··								
2	2	Bearings for brake shaft	10871 A	10871	··								
1	1	Upper bearing for clutch shaft	12968 A	12968	··								
1	1	Lower ·· ·· ·· ··	4880 NE	12828	··								
1	1	Sleeve for cut pinion	15535 A	15535	··								
	1	18" drum 7" bore	9099 AC	12480	··								
2	2	58" dia. housings	4047 BA	17290	··								
1	1	Clutch lever bracket	17220 A	17220	··								
8	8	⅝ U bolts with 2 Nuts	1-12480	12480	Forg.								
1	1	Clutch fork lever	1-17222	17222	··								
1	1	·· ·· ··	2- ··	··	··								
1	1	16½" Lever	3- ··	··	··								
1	1	2 7/16" Vertical shaft	3-17221	17221	··								
1	1	3 15/16" brake shaft	13-30528	30528	··								
1	1	18" Lever	14- ··	··	··								
1	1	16" ··	15- ··	··	··								
1	1	End loop for brake band	2- ··	··	··								
2	2	·· ·· ·· ·· ··	11- ··	··	··								
1	1	·· strap ·· ·· ··	12- ··	··	··								
1	1	·· ·· ·· ·· ··	3- ··	··	··								
1	1	Forked rod.	9- ··	··	··								
2	2	1⅜" Eye bolts 1 nut	13- ··	··	··								
1	1	12 Lever	1-13896	13896	··								
2	2	Slotted levers	2-10996	10996	··								
1	1	2 7/16" Shaft 3-0½" long	1-13906	13906	··								
6	6	1½" x 5-2" collar bolts with			··								
		2 half and 2 full nuts		13835	··								
4	4	1⅜" x 5-2" ·· ·· ··		··	··								
4	4	2" x 5-10" ·· ·· ··	1-17293	17293	··								
1	1	3 Pin with washer and split pin	17-30528	30528	Steel								
1	1	1 15/16" ·· ·· ·· ·· ··	16- ··	··	··								
100	100	⅝ x 1¾" carriage bolts	7- ··	··	··								
16	16	1" x 4-6½ rods, 5 Thrd., 2 Nuts		6660	··								
2	2	¾" x 12⅜ bolts 1 ··		··	··								
4	4	⅜" x 2⅜" ·· 1 ··		··	··								
1	1	¾" rod, brace 2'-½ long	3-17220	17220	··								
16	16	1⅜" x 4¾in bolts 1 nut		6660	··								
12	12	⅜" x 4½" ·· ·· ··		··	··								
6	6	1 x 19 bolts 1 nut for bracket 6 Thrd.		··	··								
4	4	1½" x 3-1" ·· ·· ·· brake br'gs ··		··	··								
2	2	⅜" x 2⅜ in bolts 1 nut	4-17222	17222	··								

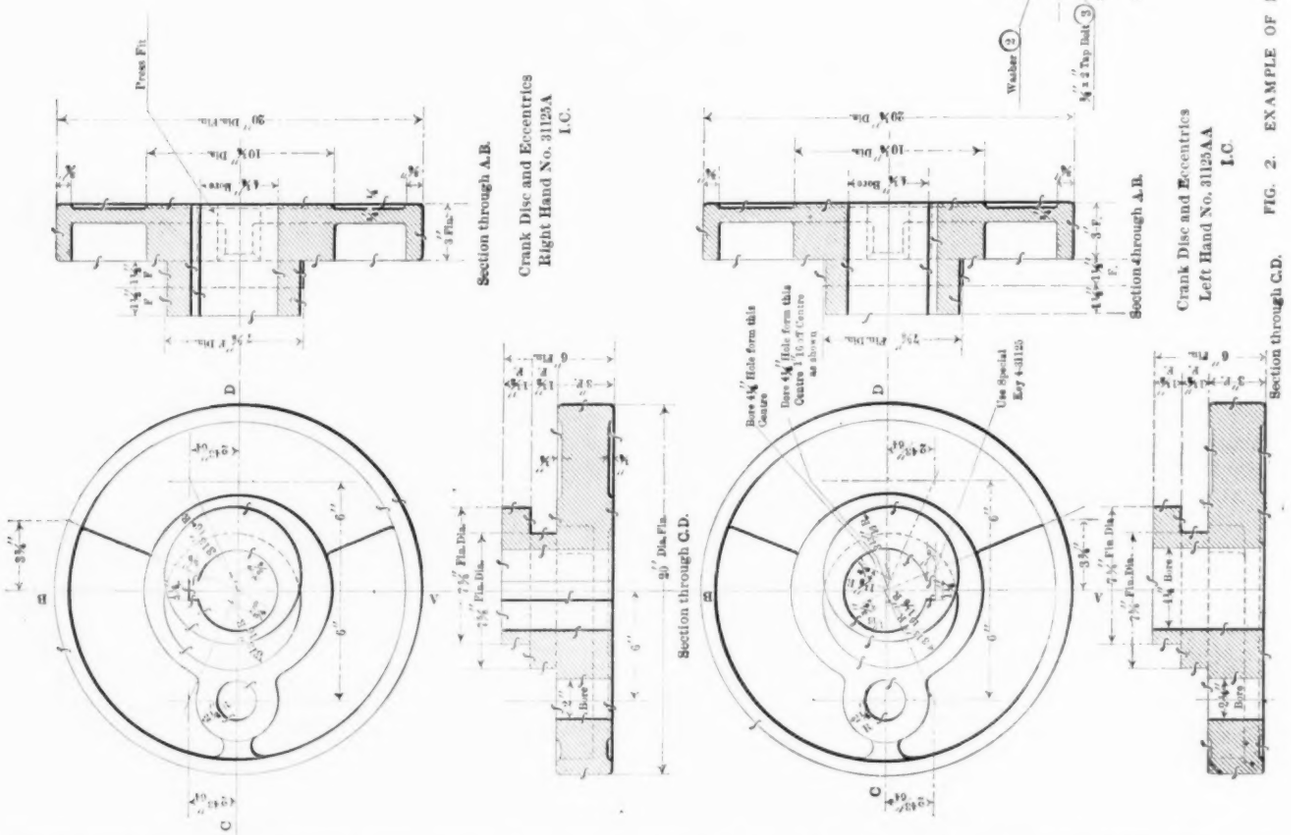
G. No.		NAME	MARK	DWG.	MAT.	S-C	C. I.	FORG.	STRUCT	MISC.	DATE ORDERED	DATE SHIPPED OR REC'D	REM.
		Dwg. No. 6660 No. of List Sections 2		Sect. No. 2									
1	1	Brake band ¼ x 6 x 15-01"	10-30528	30528	Steel								
1	1	·· ·· ⅝ x 6 x 13-11⅛"	1- ··	··	··								
6	6	Clips for bands	6- ··	··									
1	1	Washer plate	19- ··	··	··								
21	24	2 x 6 x 11⅝ blocks	5- ··	··	Wood								
1	1	2" x 6" x 8"	6- ··	··	··								
1	1	1⅜ St'd turn buckle (strap)											
1	1	1" ·· ·· ·· ··											
1	1	1" pipe separator 18"	4-17220	17220	Pipe								
1	1	80" x 22 Steel rim pulley 4⅝ double belt											
1	1	44 x 24 Wro't ·· ·· (clutch)											
1	1	16" Moore & White friction clutch											
11	11	⅛" P. T. Grease cups											
2	2	⅜" ·· ·· ··		17220									
4	4	2 St'd C.I. Washers			C. I.								
8	8	1¼" ·· ··			··								
6	6	1⅛" ·· ··			··								
22	22	1" ·· ··			··								
3	3	1⅛" ·· ··			··								
2	2	⅝" ·· ··			··								
1	1	1⅜ pin with washers			··								
		and split pins	20-30528	30528	S. H.								
1		20 Drum 7" bore		12480									

American Machinist

FIG. 1. PART LIST ON THE GROUP SYSTEM.

the machine shown on Dwg 6823 Gr. 1, and later, after the change of design, to build to Dwg. 6823 Gr. 2. All of these characteristic features of the group system are clearly shown in Fig. 1, Drawing No. 6660, which is reproduced from a part of a 23x36-inch same. It will be noted that in this case the list is written on the general drawing No. 6660, and calls for a number of small detail drawings for the various parts. The only work which the drawing-room had to do when the customer called for a and the same general drawing can often be used for the shop without change, even when some detail is different, because the title of the drawing clearly states that it was *first drawn for* Dredges 143 and 144. The drawing will always agree with Group





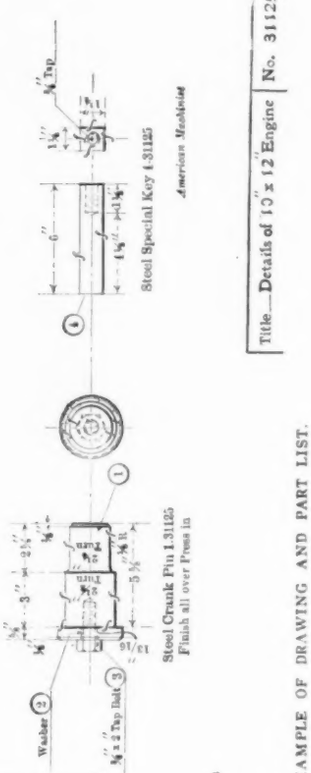

Title Details of 10" x 12" Engine No. 31125
Steel Special Key 1-31125
American Machinist
Steel Crank Pin 1-31125
Finish all over Press fit
Washer (2)
¾" x 2 Tap Bolt (3)
¾" Tap

FIG. 2. EXAMPLE OF DRAWING AND PART LIST.

general drawing of the machinery from a placer mining dredge, showing the changes resulting in the list when a 20-inch drum is put on in place of the 18-inch drum, other parts remaining the larger drum was to make a detail of the drum, and fill in Group 2 on the list drawing, as shown. Had the changes been much more extensive the work of changing the list would have been little greater, 1, and the subsequent minor changes appear at once on running the eye down the successive groups. When this same drawing, Group 2, is called for on the general list (described later) for Dredge 146, the

shop foreman knows at once that the machine is as shown, except that the drum is changed to 20 inches diameter; while on drawing 12486 he will find details of the new drum.

Fig. 2, Dwg. No. 31125, shows a half size sheet, which on our new work is generally used for details, being 18x23 inches and not too large to mount on strawboard for shop use. This also clearly shows the group list blank which we have printed on half-size and on some full-size sheets, with a heading for the second section of an extra long list printed at the bottom. If this heading is to be used, the ruling is extended below it by hand, as shown in Fig. 1. In Fig. 2 the draftsman judged that extra space would not be required, and drew details under the first list section. Also note that the list on Fig. 2 calls for the connecting rod details from a lot of other drawings. These are mostly old drawings and are listed here as the most convenient place.

We have a similar but shorter ruled section on the quarter-size (11½x18) sheets and also eighth size (9x11½) sheets which are devoted entirely to the list and are numbered with the drawings. These last with no drawing attached are quite extensively used in our work for listing the material called for on old drawings.

These are all the forms of list blank in use, except the general list, which will be described later. Note that these blanks all have a uniform heading, and that when the list on any sheet exceeds 11½ inches in length (50 lines), it is stopped, and continued as a second section under the

THE BUCYRUS CO. ENGINEERING DEPT. No. 18202 A

100 Ton Wrecking Crane No. 126

Nov. 14 1903 Draftsman Allen

No. OF SECTIONS

A B GENERAL LIST 100 Ton Wrecking Crane No. 126 No. 18202 A

LIST NO.	UNIT	ORDER NO.	GROUP DRG.	GROUP NO.	NO. OF SECTIONS	PRIN. DRG.	SUBJECT
3.126A	Car Body	20154	6911	1	2	6912	Structural details
		"	31130	1	2	"	Cast "
3.125A	Trucks	"	5697	2	2	5697	
3.126C	Brakes	"					
3.126D	Revolving Frame	"	16943	1	1	6921	Structural
			31130	2	1	"	Roller Beams etc.
3.126E	Hoisting M'ch'y	"	31121	1	2	6914	Gears and Drums
			6914	2	1	"	Clutches
3.126F	Engines	"	31125	1	1	6916	Cranks, Eccentrics, Conn. rods, etc.
			31126	2	1	"	Cylinders Valves
3.126G	Boom		6917	1	1	6917	Structural
			31134	1	1	"	Sheaves pins etc.
3.126H	Hook Blocks		31136	1	1	31136	100 Ton Block
			31138	1	1	31138	50 " " and 10 Ton Hook

American Machinist

FIG. 3. GENERAL LIST.

subhead. When sent to the shop as order lists, these prints are all exactly 9x11½ inches in size, even though a single sheet may carry only a few items. Sometimes the lower end of one of the 9x11½ prints taken from a large tracing will show some mutilated fragment of drawing. Of course the large prints from the tracings, used as working drawings, also show the lists. The large numbers of 9x11½-inch prints required are made by a special rapid blueprinting machine, which uses ready-cut blueprint paper, and will print with equal facility from the corner of a large tracing or from a 9x11½-inch list sheet.

The separate sheets of lists for a given machine are gathered together or indexed by means of a sheet called the "general list," which is written on a special blank. A general list is written for every dredge, steam shovel, pump or other order which requires more than one sheet of order list. If only one list sheet is required, no general list is necessary. A sample general list is shown in Fig. 3. It is simply a memorandum stating the name, nature and order numbers of the job, and giving the number of every drawing which carries any part of the order list, with the group called for on each drawing. A column is also provided in which the principal or general drawings are noted, for guidance in looking up the details of a job. It was at first intended to enumerate in this column all the drawings other than group drawings, but this was found impracticable, as there are too many. When all the detail drawings for a certain section or "unit" of a machine are wanted, it is only necessary to get out the group drawings, and these will give the numbers of the other drawings. Thus, in Fig. 3, if it is desired to get all the drawings showing the hoisting machinery of the 100-ton wrecking crane No. 126, I first get the general list of that crane, look for the division or unit "hoisting machinery," find that the list for this is on drawing No. 31121 Group 1 and 6914 Group 2. On getting out these two drawings I will find every item of the hoisting machinery listed, and references made to every other drawing. Sometimes there are five or six group drawings.

Before passing on to an outline of the actual workings of the system, let us note some of the characteristic features of the general list. In the first place, the number of the general list shown in Fig. 3 is 18202. It occupies two sheets, A and B. This is the only case in the Bucyrus system of drawing numbers where a letter is appended. It is done in this case so that all the sheets of general list for one job may carry the same number. The sales order for Crane 126 simply says, "To general list 18202." This is written on the sales order by the chief draftsman or drawing-room foreman, who may not know how many sheets the general list will occupy when he assigns the number. So it is convenient to designate the separate sheets by letters, each sheet showing by the letters in the upper left corner how many sheets compose the whole list. The drawing number 18202A in the upper right corner is repeated two inches lower, as the upper one is covered when the list sheets are bound for shop use.

All the columns of the general list have been sufficiently explained except the first two. These are a survival of the fittest parts of the earlier system, and while they are not elements in the new system they are so convenient that we retain them as extras. In the old system the general list took the serial number of the machine in its own class—that is, steam shovels had one series of numbers, dredges another, cranes another, and so on. The class was designated by a prefixed numeral separated by a decimal point from the serial number; thus, 1.529 is shovel No. 529 and 3.126 is crane No. 126. Then the general list was subdivided into alphabetical sections; 3.126A means a set of sheets enumerating every part used to build a car for wrecking crane, and so on. This had a very particular object. Smith has bought a wrecking crane No. 123. Jones sees it and wants one just exactly like it, except that he must have his own particular kind of couplers on the car. Jones's crane will be No. 129, and it is built to general list 3.129. To write up the lists for this new crane, it was only necessary to re-write the car body list, 3.126A, changing the kind of couplers called for, the new list number being 3.129A. A year later, some question arising as to what the difference is between the two cranes, a quick comparison between the general lists would show that the cars were built to different list numbers, while all the other units were built to the same list numbers, and were therefore exactly alike.

Thus, in the old system, we got to using these list numbers as *names*, and every shop foreman would soon know what was meant by car "to list 3.126A" if it was often repeated. Standard list numbers became familiar, while an unfamiliar list number instantly caught the foreman's eye and notified him to look for the change.

In the old system, however, the *whole car list* of several pages had to be rewritten to call for Jones's special couplers. Later, this was greatly improved by a combination system which only necessitated rewriting the page calling for the couplers. Now we merely write up a new group. But still we keep the old list numbers as memoranda to establish at a glance the identity or non-identity of the various units of machines.

A new cure for obesity is to work in the acid room of a sulphite mill for six months. When the acid room becomes a health resort the proprietors can of course charge big fees for the privilege of working in it. We would suggest the foremanship of a four-story jobbing machine shop without an elevator as another good cure.

Graphical Solutions for Spiral Gears.

BY A. THOMPSON.

Although the question of calculating for spiral gears by graphical methods appears to have been pretty exhaustively threshed out in the columns of the AMERICAN MACHINIST, with the exception of the diagram by Mr. J. N. Le Conte in Vol. 25, page 296, I have not found the methods given of any practical assistance. It seems to me as though the object of the writers was to write as learned articles as possible. This is all very well from a mathematical point of view, but what the average designer of spiral gears requires is a simple rule to cover all conditions of spiral gearing. The diagram by Mr. J. N. Le Conte was a step in the right direction, and I found it of considerable assistance in solving spiral gears for fixed center distances. This diagram, however, also has its disadvantages, as it is limited in solutions for shafts at right angles, and then only gives the angle of the spiral. In my graphic solution all the particulars of each gear can be obtained by scaling.

Previous to finding out this graphic solution I always used the formulas shown in Fig. 1, which cover all conditions of spiral gears, and I still use them as a final check to graphic solutions.

I obtained the idea for this method quite by accident. A friend gave me the following apparently simple problem to solve: A ladder 24 feet long is reared from the ground to a wall and just touches a pole 6 feet long standing at right angles to the wall, 9 feet from the ground, as in Fig. 2. How far from the wall does the ladder rest on the ground? After a little figuring I arrived at the following equation:

$$24 \text{ ft.} = \frac{6 \text{ ft.}}{\cos. EDC} + \frac{9 \text{ ft.}}{\cos. FDB}$$

which is identical with the formula for spiral gears of fixed center distance. I have now adopted this construction to solve all conditions of spiral gears. The method of procedure for solving all conditions of spiral gearing is as follows:

Referring to Figs. 3, 5 and 6, draw two lines AB and AC corresponding to the shaft angle; from each draw a perpendicular ED and FD meeting in a common point D, the length of such lines being equal to the corresponding pitch diamters of spur gears having the same numbers of teeth, *i. e.*, $ED = \frac{N}{P}$ and $FD = \frac{n}{P}$. Now a line BC drawn through point D and intersecting the shaft angle lines completes the figure, giving:

$CD = D$, $BD = d$, $CB = 2K$,
Angle $EDC = \phi$ and Angle $FDB = \alpha$.

It will be obvious that any of the above data may be used in constructing the figure and the remainder be found. When solving for spiral gears with a fixed center distance it is necessary to draw line $BC = 2K$ and touching point D. I do not know of any geometrical construction for this, but it can readily be done by sliding a

scale along $A\,C$, as shown in Fig. 3. If such length of line will not touch point D the diameters of the corresponding spur gears are not correct and will have to be adjusted accordingly.

As an illustration, take the much used case given by Mr. De Leeuw at page 30, Vol. 23: $N = 32$, $n = 8$, $P = 6$, $K = 4.468$ inches, shafts at 90 degrees. Construct Fig. 3 as follows:

$$B\,A\,C = 90°,\ E\,D = \frac{N}{P} = \frac{32}{6} = 5.333'',\ F\,D = \frac{n}{P} = \frac{8}{6} = 1.333,$$

and $B\,C$ and $B_1\,C_1 = 2\,K = 8.936''$. Then by scaling we have: Angle $E\,D\,C = 38°\ 6'$, angle $F\,D\,B = 51°\ 4'$, line $C\,D = 6.774$ = pitch diameter of one gear and line $B\,D = 2.162$ = pitch diameter of other gear; or, taking the other solution of $B_1\,C_1$, we have: Angle $E\,D\,C_1 = 26°\ 35'$, angle $F\,D\,B_1 = 63°\ 25'$, line $C_1\,D = 5.952$ = pitch diameter of one gear and line $B_1\,D = 2.984$ = pitch diameter of other gear. With shafts at 90 degrees and fixed center distance

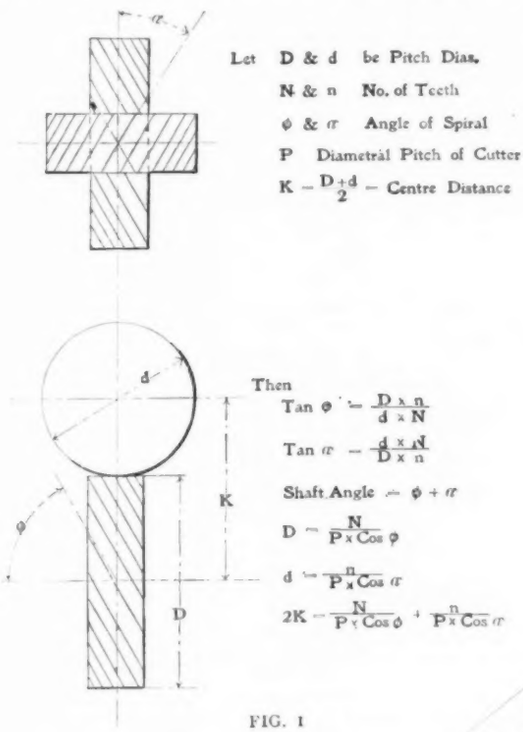

Let D & d be Pitch Dias.
N & n No. of Teeth
φ & α Angle of Spiral
P Diametral Pitch of Cutter
K = (D+d)/2 = Centre Distance
Then
Tan φ = D x n / d x N
Tan α = d x N / D x n
Shaft Angle = φ + α
D = N / P x Cos φ
d = n / P x Cos α
2K = N / P x Cos φ + n / P x Cos α
d
K
D
φ

FIG. 1

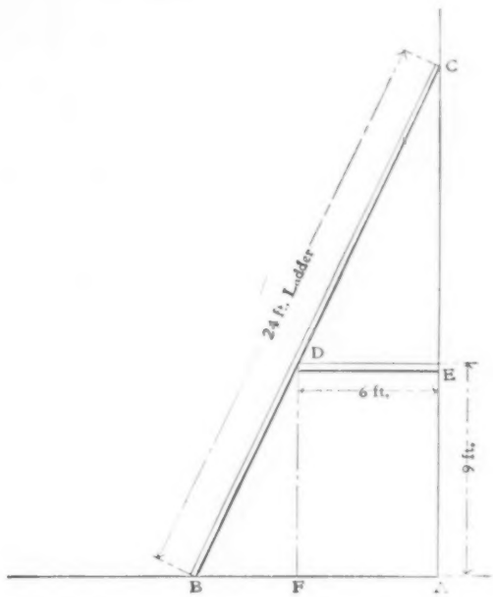


FIG. 2

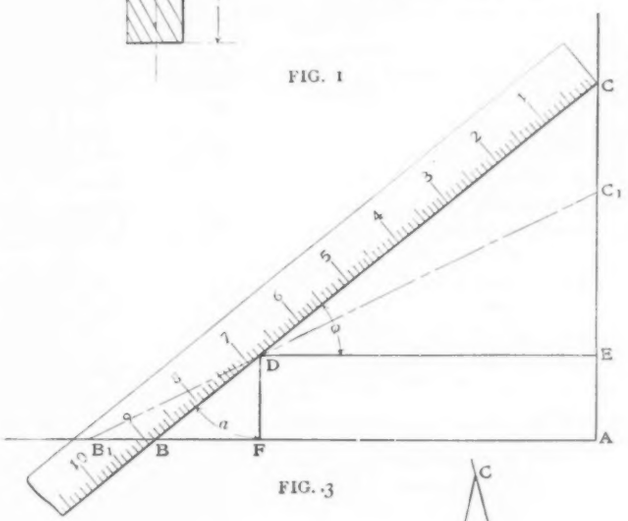


FIG. 3

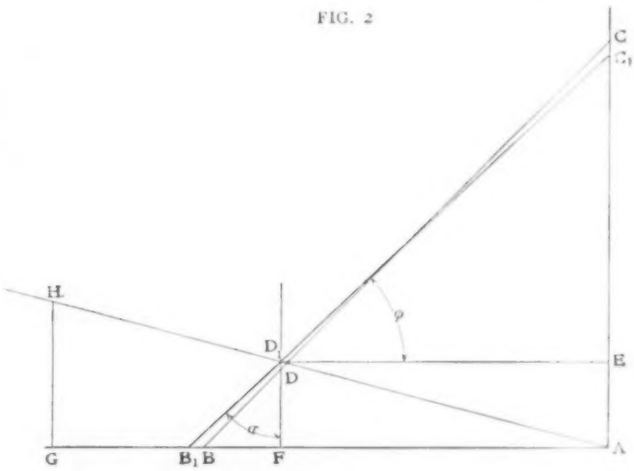


FIG. 4

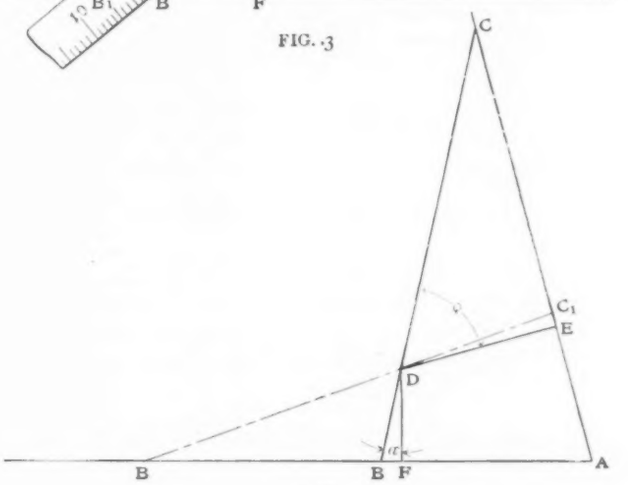


FIG. 5

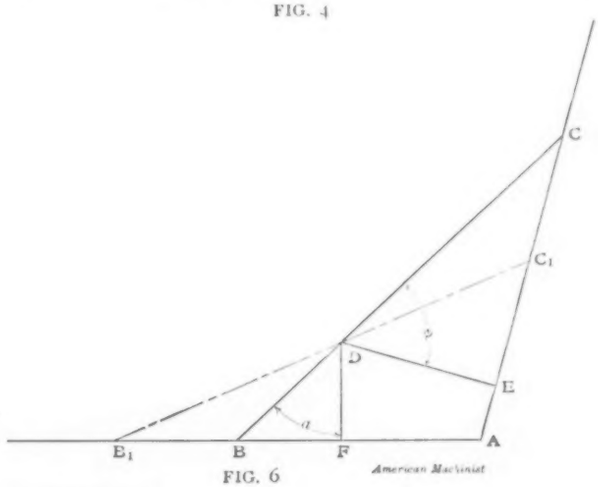


FIG. 6

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GRAPHICAL SOLUTION FOR SPIRAL GEARS.

there are but two practicable pair of spirals, of which the one that serves the purpose best should be chosen.

Were it desired to have the spiral angle as near 45 degrees (or any other angle) as possible, the procedure would be as in Fig. 4: On the base line $A\,B$ draw $B\,C$ at 45° and equal to $2\,K = 8.936''$. Through C draw $A\,C$ at 90° to $A\,B$; draw the ratio line $A\,H = 1$ in 4 ($H\,G = 1$, $A\,G = 4$) and from the intersection D scale the distance to $A\,C$, which in this case will be found to about equal 5.02". It is now necessary to find $\frac{N}{P}$ which shall be nearest equal to 5.02". This can soon be done by trial, and in this case I have taken $\frac{36}{7} = 5\frac{1}{7}''$. Now make $E\,D_1 = 5\frac{1}{7}''$, through D_1 draw $B_1\,C_1 = B\,C$, and scale as before with these results:

$D = 7.061$, $N = 36$, $\phi = 43°15'$, $P = 7$.
$d = 1.875$, $n = 9$, $\alpha = 46°45'$,

For solutions for shafts other than at 90 degrees refer to Figs. 5 and 6. Assume a shaft angle of 75°, or 105°, and $N = 20$, $n = 12$, $P = 4$, $K = 7''$. Construct the figures as before, making $B\,A\,C$ equal to the shaft angle; in Fig. 5, 75°, and in Fig. 6, 105°. Draw $E\,D$ perpendicular to $A\,C$ and equal to $\frac{N}{P} = \frac{20}{4} = 5''$; draw $F\,D$ perpendicular to $A\,B$ and equal to $\frac{n}{P} = \frac{12}{4} = 3''$; draw $B\,C$ and $B_1\,C_1$ to touch point D and lines $A\,B$ and $A\,C$ equal in length to $2\,K = 14''$. Then by scaling we shall get four sets of gears which will fulfill the conditions, *i. e.*, two from Fig. 5 and two from Fig. 6, all of which are given in the table.

Any of the above pairs of spirals may be used, and preference should be given to those whose angles come nearest to 45 degrees, *i. e.*, the first pair of Fig. 6.

Gainsborough, England.

	36 T and 9 T, 7 P.		
1st pair Fig. 5	$E\,D\,C = 62°\,45'$	and	$F\,D\,B = 12°\,15'$ = Angle of spirals.
	$D\,C = 10.92''$	"	$D\,B = 3.08''$ = Diams. of pitch circles.
2d pair Fig. 5	$E\,D\,C_1 = 4°\,30'$	"	$F\,D\,B_1 = 70°\,30'$ = Angle of spirals.
	$D\,C_1 = 5.015''$	"	$D\,B_1 = 8.985''$ = Diams. of pitch circles.
1st pair Fig. 6	$E\,D\,C = 58°\,50'$	"	$F\,D\,B = 46°\,10'$ = Angle of spirals.
	$D\,C = 9.67''$	"	$D\,B = 4.33''$ = Diams. of pitch circles.
2d pair Fig. 6	$E\,D\,C_1 = 38°\,10'$	"	$E\,D\,B_1 = 66°\,50'$ = Angle of spirals.
	$D\,C_1 = 6.36''$	"	$D\,B_1 = 7.64''$ = Diams of pitch circles.

TABLE OF RESULTS OBTAINED FROM FIGS. 5 AND 6.

The Engineer has another and most serious grievance against America. It seems that the publishers of the Encyclopædia Britannica have devoted more of its maps to America than to England. In fact, considerably over one-third of all the maps are devoted to America. One might think this was due to the fact that America is so much larger than the British isles (about thirty times larger), but we are cut off from this line of defense by our contemporary calling attention to the fact that Canada with 31,000 square miles greater area than the United States is obliged to get along with only 11 maps to our 104. We might say that this is because there are so many more large cities here than in Canada, and that a single State of our forty-five exceeds all of Canada in population by over 2,000,000, making it necessary to show the country on a larger scale; but after all the real reason is, we suspect, that the E. B. is sold in America in far greater numbers than anywhere else, notwithstanding its glaring defects for American use.

System for Checking Up Inquiries Caused From Advertising.

BY G. K. WILLAND.*

The necessity of judicious advertising is too well known among manufacturers and dealers to-day to admit of much comment, but a means of checking up, whenever possible, either inquiries or orders which are directly traceable to a particular advertisement or advertising medium is a very important factor to the advertiser.

Presuming that he has distributed his advertisements among several magazines and papers, and that answers commence to come in asking for catalogs and prices, he wonders which particular papers are responsible for these inquiries, as few bear the stamp of recognition. It is very essential, therefore, that some manner of checking them be adopted if he wishes to know where his money is being spent to the best advantage. It is this fact that led to the adoption of the following system in our advertising department.

In the manufacturing business with which I am connected, the custom of keying our advertisements is usually employed. This method, as is well known, is by numbering or lettering the catalog to be written for such as "Write for Catalog 12" or "Ask for Circular D," where, as a matter of fact, the advertiser has but one catalog or one circular describing the article advertised. Another way sometimes used, when the advertiser is well known to the postoffice officials of his own city, is to use an incorrect number to his street address, such as No. 141 Gold street instead of No. 41 Gold street, his true place of business. By this

FILE.

NOTICE

TO ASSIST US IN CHECKING UP OUR ADVERTISEMENTS, WE WILL THANK YOU TO INSERT A CROSS (X) OPPOSITE THE LINE SHOWING THE MEDIUM OF YOUR INFORMATION.

Our attention was called to your (machines) (stands) by an advertisenent in—

(X) American Machinist.
( ) Machinery.
( ) The Iron Age.
( ) Palmer's Buyer.
( ) Engineering Magazine.
( ) Cassiers Magazine.
( ) Manual Training Magazine.
( ) W. P. I. Journal.
( ) Science and Technology Annual.
( ) Western Drawing Teachers' Association
( ) N. E. Teachers' Association Metal Work
( ) a Circular.
( ) seeing one in use.
( ) a user's recommendation.
( ) a Dealer's Recommendation.

PLEASE GIVE NAME OF SAME

OTHER SOURCES

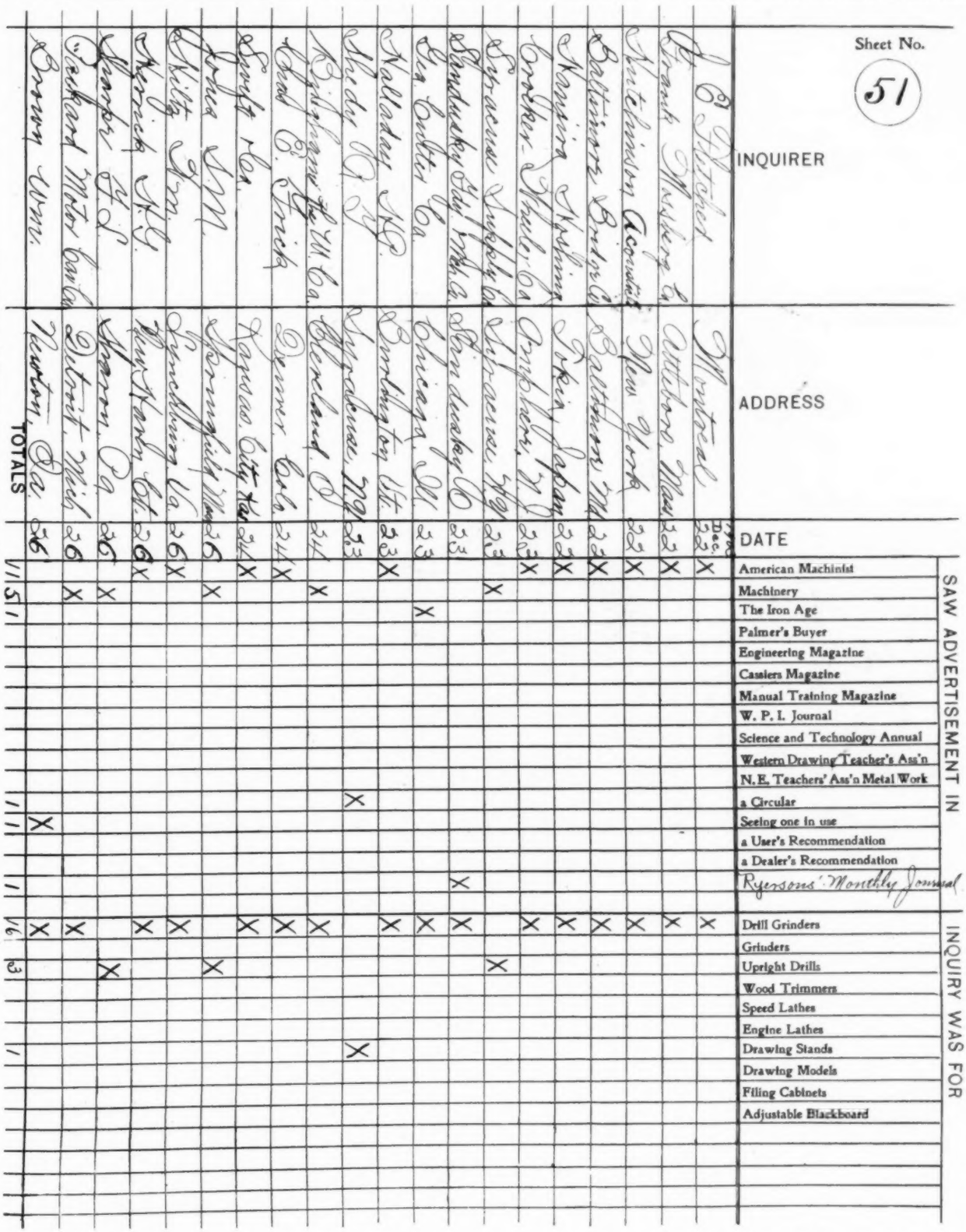
Very truly yours,
H. A. Rohrich.

FAC SIMILE OF RETURNED POSTAL CARD.

*Secretary, The Washburn Shops, Worcester, Mass.

keying of the ad. we are enabled to ascertain the source of certain inquiries. Many inquiries, however, are written some little time after the advertisement has been read and the only things borne in mind by the person inquiring are: the name of the advertiser and the article advertised, the number of the catalog or the designating letter of the circular having entirely escaped his memory. To reach the source of these inquiries, therefore, we have the following method:

Fig. 1 represents a postal card having a printed list of the periodicals in which we either advertise or have advertised. To the left of each name is a small space as shown by the parentheses. One of these postals is enclosed with our reply and, having our name and address printed on the front side, the inquirer has but to draw his pen through the word (machine) or (stands), make a × in the space opposite the name of the paper or magazine in which he saw our advertisement, sign his name and drop the card in the mail. Herein lies the real assurance of our request being complied with, as the card contains all the information we require excepting his × and signature. Fig. 2 represents a sheet cross-ruled, having a



FAC SIMILE (SLIGHTLY REDUCED) OF RECORD SHEET SHOWING SOURCE AND CHARACTER OF INQUIRIES.

column for the name of the inquirer, one for his address and one for the date of the inquiry. The balance of the sheet is divided into two sections under the titles "Saw Advertisement In" and "Inquiry Was For." Under this first section is a list of the papers as printed on the postal shown in sketch 1, with a few blank spaces for additional names should further advertising contracts be made. Under the second section is a list of the principal machines and supplies we manufacture and advertise, also spaces for new tools which may be later added to our line.

The name, address and date of every inquiry are entered at the time we receive it on this sheet and a check mark placed in the column under the name of the article or articles inquired for. As soon as the postal has been returned containing the information for which it was intended, a check mark is made under the name in Section 1 corresponding to that which the × on the postal represents. The postal can then either be filed or destroyed, as the main purpose for which it was intended has been accomplished.

When a sheet becomes filled, the columns are added and the totals brought down; Section 1 showing the total number of inquiries received from each advertising medium, and Section 2 the total number of inquiries for each article. The small circle in the upper left-hand corner marked "Sheet No." is then filled in and the sheet filed away for the present. At the end of the month or quarter the sheets are brought out and the totals added. We are thus enabled to see which paper brings the most inquiries and to know which we desire to increase and which to decrease our advertisements in.

When the new year commences and it is time for us to again place our contracts for advertising, we are enabled to do so with a much better understanding than if we depended upon the figures given us by the representatives showing the circulation of their respective papers; this information being obtained with but a small amount of labor and at a very slight cost.

Vertical Boring Mill Feed Gear.

At page 376, Vol. 26, we illustrated the 34-inch vertical boring and turning mill built by the Colburn Machine Tool Company, of Franklin, Pa., and we now present more fully than at that time the arrangement of the mechanism for operating the feeds. The half-tone illustrates the upper part of the mill and shows also at the end of the rail the attachment employed for thread cutting.

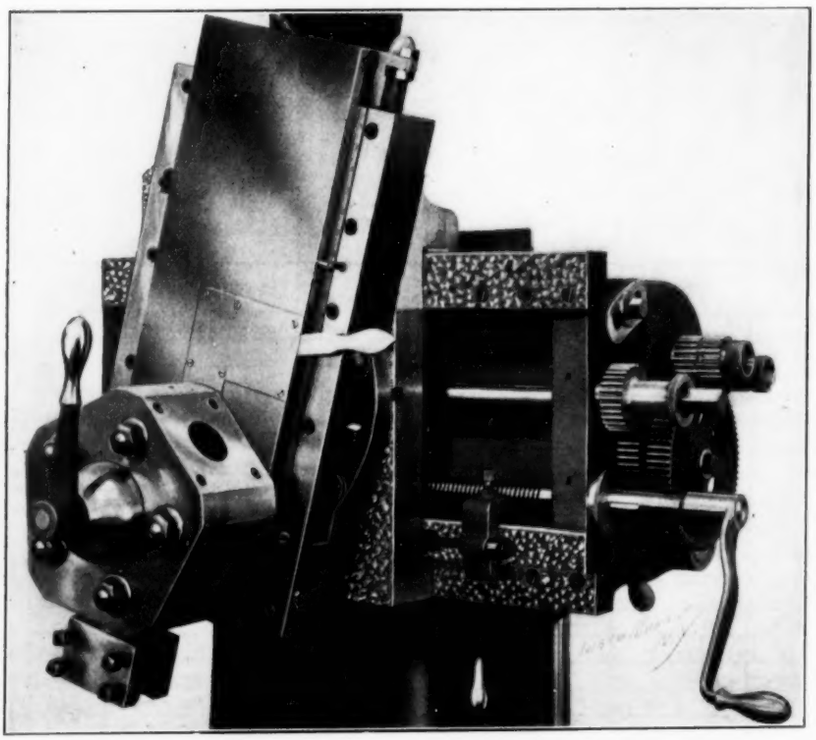


FIG. 1. VERTICAL BORING MILL HEAD.

The machine is fitted with a plain table, or with universal and independent three- or four-jaw chuck, and through a two-speed countershaft, a four-step driving cone and back gears has sixteen table speeds ranging from 2 to 67 turns per minute. The feeds are eight in number. The vertical and angular feeds range from 0.0125 to 0.125 inch, and the horizontal from 0.025 to 0.250 inch per turn of table. The four-step driving cone, as illustrated in the earlier article, is keyed to a sleeve running loosely on the main shaft when the back gears, which are thrown in and out through the medium of an eccentric shaft, are engaged. When driving direct this sleeve is connected to its shaft by a sliding clutch inside the small step at the outer end of the cone. Motion is transmitted from the driving shaft to the work table by a pair of bevel gears and a vertical shaft which carries at its upper end a spur pinion engaging with the gear attached to the underside of the table. Near the inner end of the driving shaft is a spur gear which drives in either direction, through reversing gears on a tumbler plate a short shaft shown at *a*, Fig. 2, which shaft through bevel gears actuates the vertical worm shaft *b*. Shaft *a*, it will be observed, is carried bodily in a sleeve, and at a point just outside the wall of the base the enlarged end of a lever fits over and embraces this sleeve to form a means by which the latter may be turned in its seat and either of the reversing gears carried at its inner end thrown into mesh with the spur driver on the main shaft. The reversing lever has three positions and in the intermediate one both intermediate pinions are of course clear of the driver and no motion is communicated to the vertical worm shaft. The latter is broken out at the middle of its length, and it should be explained here that the driving gear at the bottom is turned one-quarter way round from its real position, in order that it may be more clearly represented; actually, however, shaft *a* should be parallel to the cross-rail above.

The worm at the top of shaft *b* drives through a worm wheel, as indicated, a shaft on which is formed a long pinion *c*, the shaft having at either end a bearing in a sleeve fitting a cylindrical part of the gear casing. This portion of the case, while enveloping the pinion, has ample space between its inner surface and the pinion teeth to receive the sleeve-like hub of a swinging and sliding member *d* which also envelops, yet clears, the pinion. This swinging casting carries at *e* a gear which, extending through an opening in the cylindrical wall, engages with and is driven by the long pinion *c*. Directly above *e* is journaled in the casing a shaft on which are keyed four gears of different diameters; two of these may be seen at *f* and *g*, and with any one of the four *e* may be engaged at any time by simply sliding bracket *d* along as far as required and then swinging it up until its gear is enmeshed with the required gear in the cone above, when the eccentric handle at the end of *d* may be operated to bind this swinging member fast to the rear wall of the casing. This wall is, of course, notched at four points opposite the gears to admit the thin end of carrier *d* and allow it to be swung up to the required hight. Above and to the left of the nest of gears is a shaft *h* adapted to run in two sleeves each of which is a running fit in a bearing formed in the side wall of the gear case; at the inner ends of these sleeves are secured two gears *i* and *j*, meshing respectively with the smallest and largest gears in the

cone below, and between them is feathered on the shaft a clutch *k*. The latter, through the medium of a crank handle *l*, an eccentric pin to which this handle is attached, and a shoe at the inner end of the pin which fits a circumferential groove in *k*, may be shifted to right or left and either gear *i* or *j* clutched to shaft *h*. Hence, as will be seen, the latter shaft has for each speed of the set of gears below two rates of speed, and for each speed of the long pinion *c* and of the work table eight different speeds; thus are obtained for each speed change the eight positive rates of feed—either horizontal or vertical—for the head, the lever position for any feed being obtained instantly by reference to a conveniently located table at the rear of the gear casing.

The gears connecting shaft *h* with the cross-feed screw and with the rod for actuating the vertical and angular feeds are clearly shown in this line engraving and in Fig. 1. It will be seen from the former that this shaft carries at its outer end a pinion which engages with the larger of two gears secured to a shaft journaled below and a little to the front of *h*. The smaller of these two gears meshes with a gear mounted loosely on a supporting stud and engaging in turn with the slip pinion on the feed rod; the large gear engages directly with a slip pinion carried, when in position, by the cross-feed screw, but not shown in place in the half-tone. The micrometer dial on the screw, owing to the removal of the pinion, is plainly visible. Also in the sectional view of the head will be seen clearly the arrangement of the cross-feed nut and the rack and gearing for operating the up and down feeds.

For screw-cutting purposes the arm represented in the half-tone is attached to the side of the gear case, and this attachment may remain permanently in position if so desired without in any way interfering with the operation of the regular feeds. The attachment swings about the shaft on which is keyed the large spur gear, and carries, as shown, two gears clutched together and one of which is driven from a special slip gear placed on the end of shaft *h*. Fig. 2, while the other meshes with the large gear below, the slot at the top of the attachment allowing it to be swung into and out of gear readily. The adjustable stop clamped to the bottom of the rail serves as a depth gage when cutting threads. An 18-inch scale will be noticed on the face of the swivel guide, and directly over it and attached to the turret slide an adjustable pointer or indicator. In cutting a thread, when the tool has passed over the work, it is backed away by the cross-feed screw handle, and the handle *l* is then moved to its mid-position, disconnecting and stopping shaft *h* and the vertical feed, though the table continues rotating. By means of the usual handle the turret slide is then raised until the pointer reaches a predetermined point on the scale, when the feed gear is again connected; and as the clutch on shaft *h* and the clutches formed on the gear hubs at either side are single-tooth affairs the tool must follow the correct path each time if the slide is returned to the correct point before engaging the feed.

The construction of the mechanism by which the vertical worm shaft driving the feed gear is swung forward or back to engage or disengage the worm gear will be understood from Figs. 2 and 3. The lower bracket with the bevel driving gears is pivoted about the reversing shaft in the manner indicated; the upper bearing *m* just below the worm is drawn forward by the lever, connected as shown at the front, and is held with the worm and gear properly enmeshed by a latch *n* which is forced downward by the pressure of a coiled spring carried by the movable member under the worm; this spring, when the latch is tilted upward, also forces the worm out of gear again and releases the feed. The automatic release for the feed is obtained by means of a vertical rod *o* resting on the front of the latch and pressed downward at the required instant by the movement of an arm *p*—with a bearing screw in its end—carried on a shaft which is mounted at the top of the rail. This shaft is actuated to release the vertical feed by means of a feathered rocker arm *q* (which slides with the saddle), pins *r* and *s*, swinging plate *t* and adjustable block *u*, the latter being movable up and down along a guide provided at the edge of the turret slide. As the beveled edge of this adjustable member comes in contact with the end of pin *s* carried in the turret slide block, the pin is forced back, swinging plate *t*—which is hung at the front of the saddle upon which the turret guide swivels—and causing pin *r*,

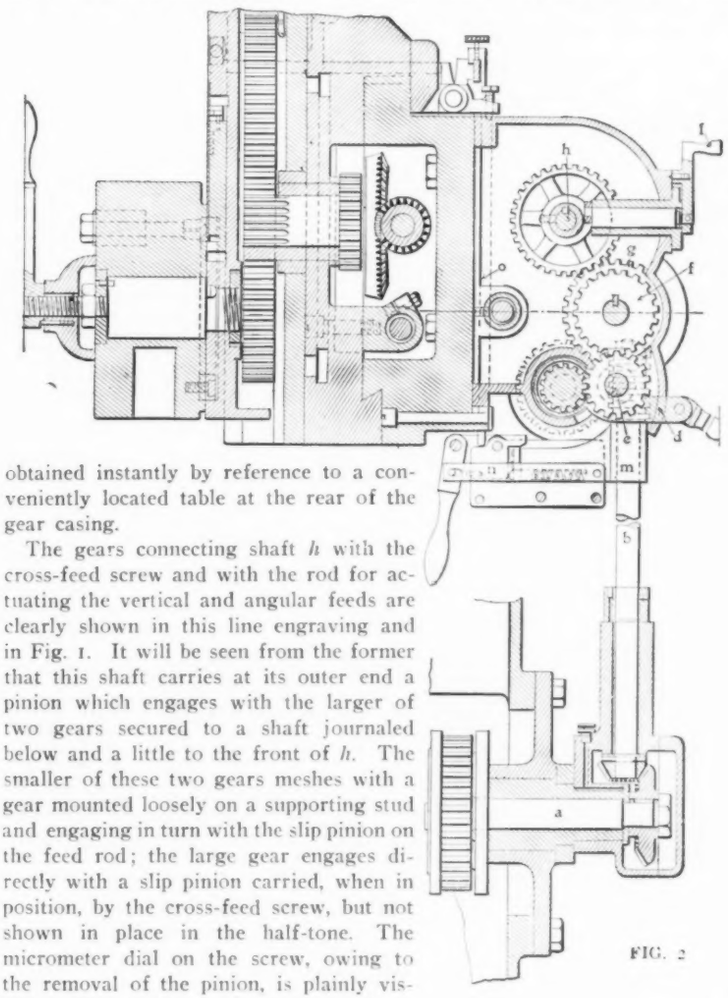


FIG. 2

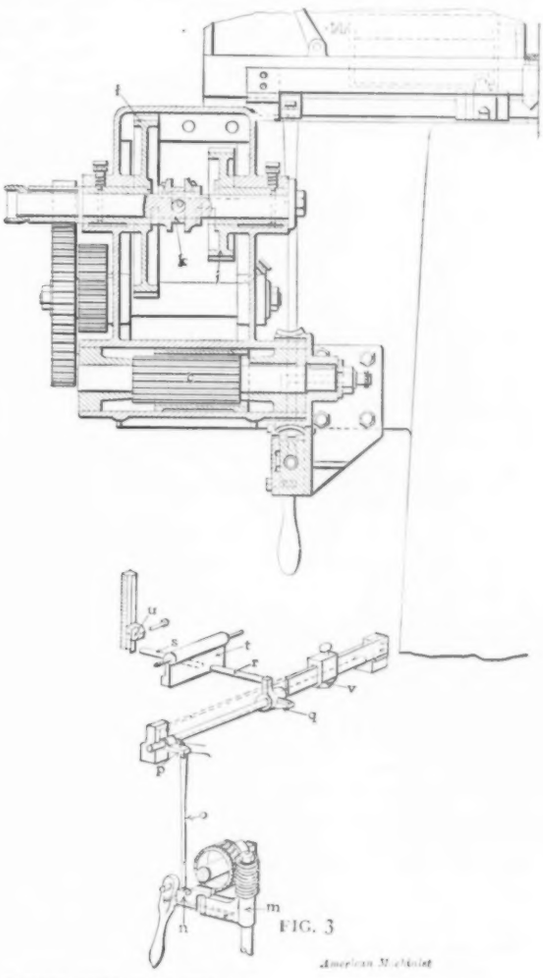


FIG. 3

BORING MILL FEED GEAR.

also carried in the saddle, to rock the shaft and part *p*, thus disengaging the feed driving worm and gear. Plate *t* is of such a width that, no matter what angle the swiveling head may be set at, the pin *s* will still strike the plate and throw out the feed. The horizontal or cross-feed is automatically released by an adjustable shoe *v* carried on a bar attached to the rear of the rock shaft supports, this shoe, when the head has been fed to the required point depressing the end of the traveling rocker *q*, when the worm gear is disconnected in the manner already described.

A Machine Prick Punch—Square—Lapping Block—Roller V Block—Scribing and Hight Gage.

BY JOS. M. STABEL.

A progressive mechanic is always on the alert for something new in the way of a tool that he can make and add to his collection; he is particularly interested when such a device is not on the market, as he then knows that he may be one of a few to possess such a tool. Week after week the AMERICAN MACHINIST is looked over by many who are seeking for new ideas in the tool line; I must confess I am guilty in this respect also. Of the tools shown herewith, some are of my own design, others are not; nevertheless they are all very handy and any one of them would be an appropriate addition to any collection.

The tool in Fig. 1 is a center punch of a design original with myself. It was constructed for use on work requiring accurate laying out. Suppose a die is being laid off that has to have numerous holes bored through it, these being located at different distances from each other, and the accuracy of the results depending upon the skill of the man laying out the work by the simple method of intersecting lines with his scratch or hight gage and making a small center punch mark at the point of intersection, then indicating and boring each hole in the lathe. I hope the reader will not think that I advocate this method for producing accurate work; I do say, however, that a good share of such work can be dealt with in this way with very small errors. If it were absolute accuracy we were looking for, we should of course avail ourselves of the button, block, or some similar method. To prick punch such lines at their true points of intersection is no easy matter with an ordinary center punch, hammer and magnifying glass, because when the punch is located in position with the aid of the glass the hand holding the latter must release it to take up the hammer, and this may allow the center punch to be moved a bit before the indentation is made. With the punch shown this trouble is prevented, as the tool is so constructed that it will strike its own blow—not necessarily a heavy one, but just heavy enough to make a small indentation to work from.

The punch when in use is held vertically with the left hand, and by means of the magnifying glass held in the right hand located as accurately as possible. The knurled body *a* is then pressed downward over the punch *b*, thereby compressing the two springs *c* and *d*, the latter being used to return the sleeve to its original position after the blow has been struck, while the former presses against hammer *e*, which is held up by lever *f* and tripped by the lower end of this lever or trigger coming in contact with the shoulder *g*. When the tripping action takes place the shoulder on the punch projects above this shoulder, thus allowing the hammer in its descent to strike the punch. The pressure of the hand is then removed, allowing spring *d* to lift the knurled sleeve; member *f*, at the end of the upward movement of *a*, being returned automatically to position under the hammer. The length of this punch over all is about 3¾ inches, and the outside diameter of the knurled shell about 7-16 inch.

Fig. 2 shows a tool that will easily stand on its own merits. I did not originate it, but whoever did should be given full credit, as it certainly is very useful; in fact, I consider it one of the handiest tools in my collection. It is used in connection with a surface plate, consequently it is called a "surface square." The tool-steel body *h* is drilled and slotted to receive blade *i*, care being taken when milling the slot to get it at right angles with the bottom. There are also in the body two tapped holes to receive the adjusting screws *j* and another hole to receive the pin *k* on which the blade is pivoted and by the two screws carefully adjusted. Both blade and body are hardened, and the important surfaces—the bottom of *h* and the beveled and straight edges of *i*—ground and lapped. As shown in the drawing, the bottom of *h* is chambered out, to give the tool a proper bearing surfa e.

Another small and inexpensive tool is shown in Fig. 3. This no doubt is familiar to a good many; nevertheless it may be that its usefulness is not fully appreciated, so a few words in regard to it may not be out of place. It was made for lapping snap gages, after these have been ground out to within 0.0005 inch of size, and Fig. 4 will give the reader a clear idea of the manner in which it is used. The body, which is made of cast iron, is composed of two pieces held together by a dovetail joint and gib, two small screws holding the gib in position, while the three knurled head screws serve to lock one sliding member of the body at any point along the other. To accomplish accurate lapping, the lap is first ground off so that both sides will be perfectly parallel, then each side is charged with flour of emery from a large bench lap. This adjustable lap is suitable for finishing snap gages ranging from ¼ to 1¼ inches in sizes.

Fig. 5 shows a small device which has proven itself very handy on close work. It takes the place of the ordinary V-block, and, if built carefully, may be used to advantage in handling nice work on the surface grinder. Each of the two cylindrical pieces *l* has a ⅜-inch hole through it which is relieved at the center to give a bearing at either end; both cylindrical parts are hardened, ground and lapped, and the holes are concentric with the outer diameter. The two plates *m* are made from flat stock planed up; as the corresponding holes through the plates must be in perfect alinement, the pieces are soldered together and the holes bored out in the lathe. The pins *n* are hardened and ground and one end of each is tapped out to receive one of the screws, which hold the parts in position. The utility of this device can readily be seen; as a large number of different diameters can be accommodated, it can be employed to good advantage on many different styles of work.

To conclude with, I shall show a tool constructed for laying out and testing fine work. It has a range by thousandths, from zero up to 5 inches, the adjustment being accomplished by the plug fitting the five bushed holes in the beam and slide, and the micrometer screw at *o*. The holes serve to divide accurately the 5 inches into equal steps, while the screw and micrometer nut *p* give the fractions of an inch in thousandths. The beam *q* fits into base block *r*, and is secured there by tapered dowels. An easy way to obtain a rectangular hole in such a block is to mill a slot of the desired width, starting at the rear end of the block, and then fit a piece of steel, as shown at *s*, in the rear part of the slot, this piece being secured in place with dowels. Also through the forward part of the block there is a slot which allows the measuring or scribing jaw *t* to come flush with the bottom of the base; this jaw, as well as the base block, is hardened and accurately lapped. The knurled head screw *u* bears against a flat spring which always holds the slide in position when the hardened and lapped plug *v* is withdrawn. The micrometer screw, which has 40 threads per inch, is splined and slides on a key which is inserted in the slide. Against this key the tapered and knurled screw *w* bears, thus locking the micrometer screw at any point. One of the most essential points when building a tool of this description is not to have the bushing holes in perpendicular alinement; in other words, they do not want to be located so that the plug *v* can be entered into No. 3 hole in the slide and yet go in No. 1 or No. 2 hole in the beam.

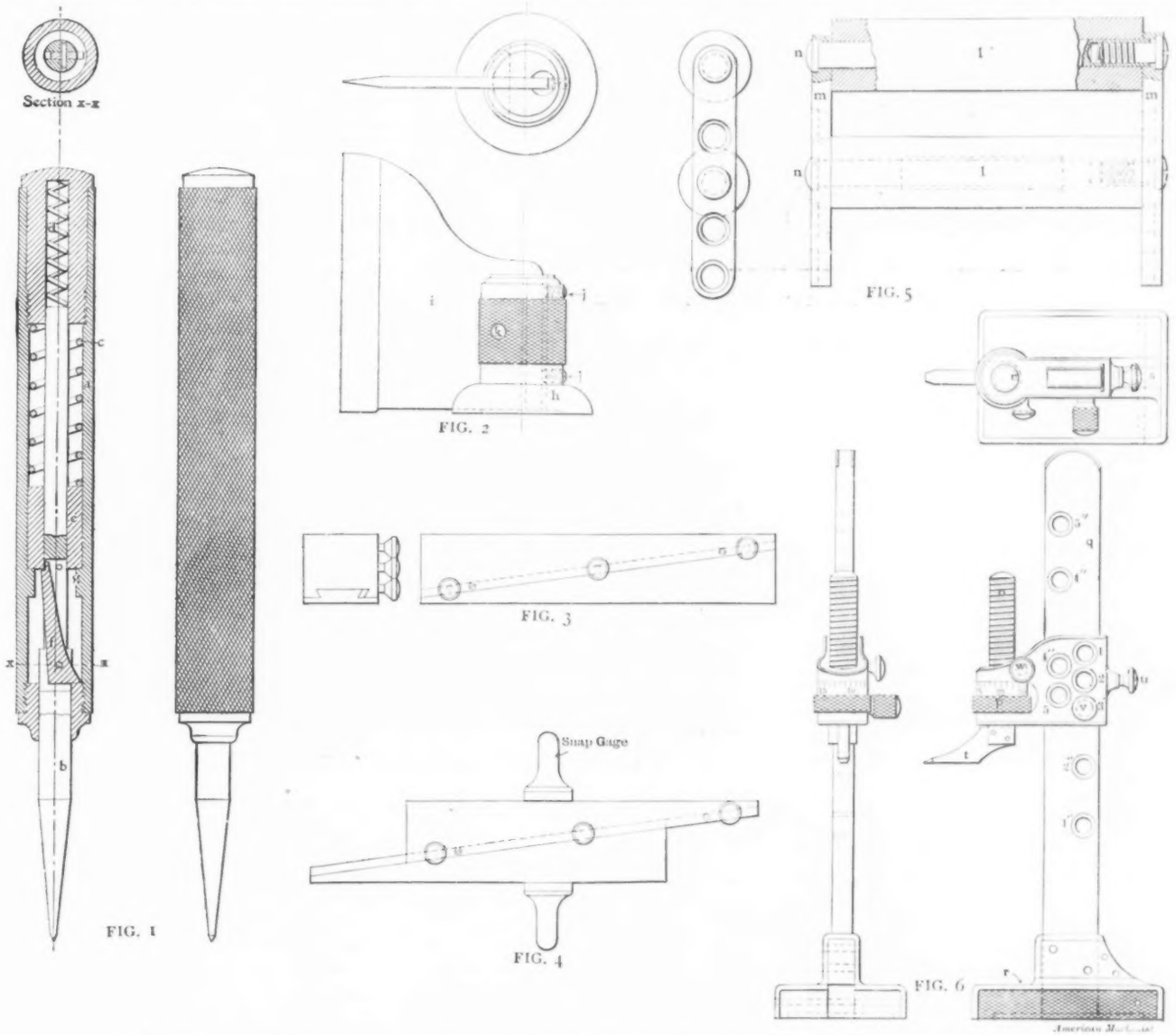
The rectangular hole through the slide is formed in the same way as the hole through the base block—that is, by milling a slot and inserting a piece of steel at the open end. The micrometer nut *p* is made in two parts; the knurled and graduated ring being a press fit on a hardened and lapped nut. The advantage of this construction is that it allows the tool to be correctly adjusted without much trouble.

Report on Ship Subsidies.

The New York Board of Trade and Transportation, which is taking up the subject of our merchant marine, particularly with reference to the proposed subsidizing of American ships, has issued a pamphlet entitled "The Merchant Marine," which consists of a majority and minority report of the committee appointed to consider the subject. The majority report is signed by Aaron Vanderbilt, chairman, and by four other members of the committee. It presents the familiar arguments in favor of subsidies, regretting the low estate to which our merchant marine has fallen and giving the great benefits that are expected to follow the granting of subsidies. The minority report is signed by a single member of the committee, Mr. Hermann Sielcken. He attributes the shrinkage in American shipping mainly to the fact that this country is so prosperous that it can employ its capital and labor in other lines that pay a better return than can be obtained in competing with the nations of the earth, as they would have to do if they entered into the shipping business, and that therefore the country as a whole is to be congratulated upon this condition rather than commiserated upon it. Instead of saying that "trade follows the flag" he says that "trade follows the price and not the flag," and instances the condition of the French merchant marine, which is operated under heavy subsidies and which he declares is in a state of utter decay, it having been shown that French ships have been built for the subsidy and not for the trade. He says that England and Germany are leading the mercantile marine without government aid; that France, on the other hand, under liberal subsidies, is losing ground and that he does not believe it is advisable for this country to follow the example of France.

The members of the American Society of Civil Engineers will find a strong argument in favor of the Union Engineering building, so generously offered by Mr. Carnegie, when they read of the arrangements for the impending annual meeting, the details of which we print in another column. It appears that the society has already outgrown its new house, and the existing lunchroom (of considerable size) must be supplemented by the temporary conversion of the auditorium to the same purpose. A tinge of humor lies in the fact that the actual meeting will be called to order in the "Carnegie Lyceum," a public hall, whence, having transacted their business, the members will adjourn to their own building for luncheon!—*The Railway Age.*

The following is used for coloring iron blue: 4⅜ ounces of hyposulphite of soda are dissolved in 1 quart of water and 1 1-6 ounces of acetate of lead in another quart of water. The two solutions are mixed and made to boil and the iron is immersed. The metal takes a blue color such as is produced by heating it.



MACHINE PRICK PUNCH—SQUARE—ADJUSTABLE LAPPING BLOCK—ROLLER V BLOCK—SCRIBING AND HIGHT GAGE.

Automobile Construction—V.

BY HUGH DOLNAR.

The cylinder or cylinders and crank-box are the important pieces of the wagon motor, and the finishing of them is the most important machining operation to be performed in driving mechanism construction. In most cases the cylinders or crank-box support everything, or are made to at least form the principal supporting element of the whole driving combination, and it is perhaps best to insert here all the material collected which relates especially to cylinder boring.

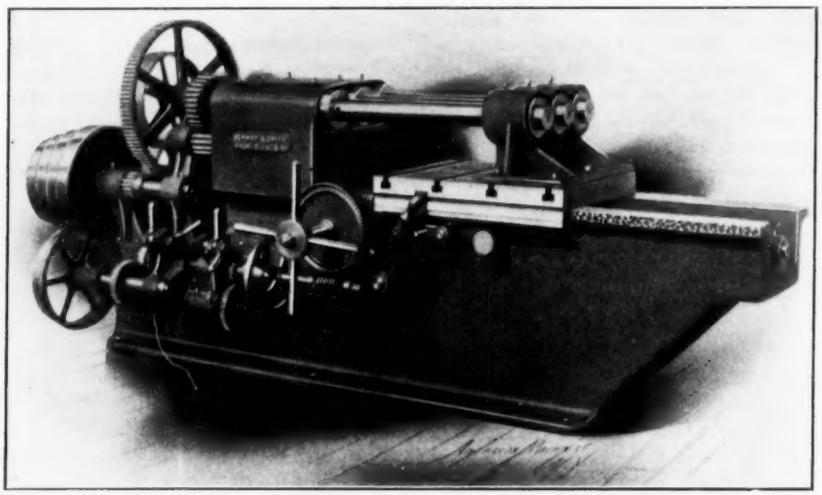


FIG. 12. TRIPLEX BORING MACHINE FOR AUTOMOBILE CYLINDERS.

The cylinders of the steam wagons are very small, from 2½ to 3 or 4 inches bore only. The Geneva steam wagon, using from 450 to 750 pounds steam pressure generated in the peculiar Geneva coil boiler, drives a 1,500-pound wagon with a pair of 2⅝-inch cylinders. Stanley and the "Locomobile" and "Mobile" use about 3 inches bore. Grout Brothers, Orange, Mass., use cylinders up to about 4 inches diameter, so that the steam cylinders used for automobile driving are quite small, and none of them, so far as I know, are bored on tools specially built for the purpose. The steam cylinders are quite often cast in pairs together, and the pair might well be bored simultaneously. At Stanley's, Newton, Mass., April, 1903, the cylinders, cast two in one piece, were being bored on a single-spindle upright driller, one cylinder at a time. I do not remember to have seen a two-spindle boring machine working on cylinders in any of the steam wagon shops, nor to have seen any steam cylinder finishing operations at all out of the ordinary jobbing shop practice.

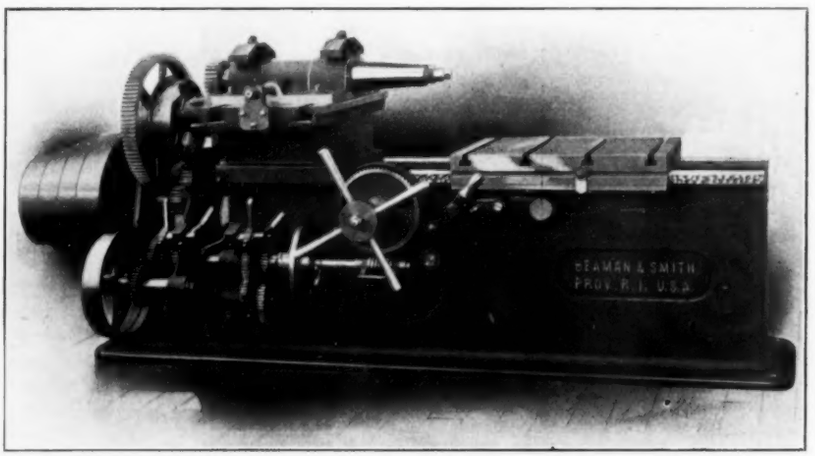


FIG. 13. DUPLEX BORING MACHINE FOR AUTOMOBILE CYLINDERS.

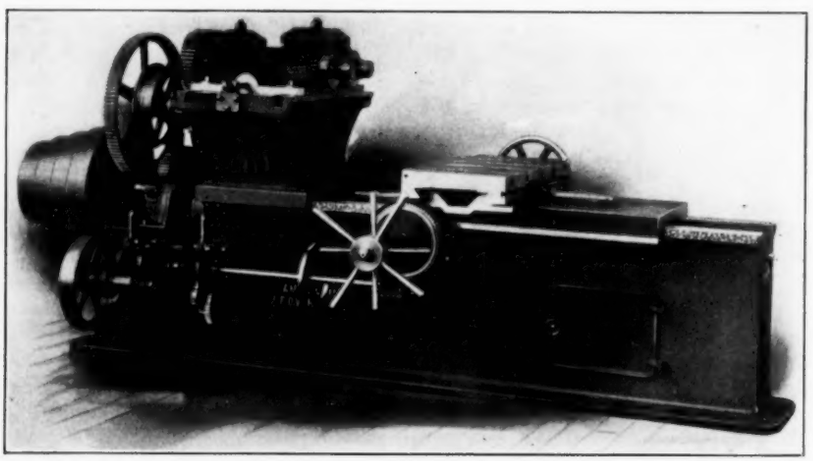


FIG. 14. DUPLEX BORING MACHINE FOR AUTOMOBILE CYLINDERS.

All of the gasoline motor cylinders are single pieces, no matter how many cylinders may be used to drive one wagon, and these single pieces are often bored separately, with a single boring bar. In May, 1903, the Stevens-Duryea pair of opposed cylinders were being bored, one at a time, on an ordinary engine lathe, with an ordinary boring bar of the simplest form, a round bar with boring tools not more, I think, than ½ inch diameter, put through the bar and held with set-screws, only one cutter working at a time. The Stevens-Duryea cylinders are open at both ends. All of the automobile builders finish the cylinder bore as well as they know how, as this is a vital point in motor construction, but some do the work at much less cost than others. At the Winton shops the cylinders (which are peculiar, and will be specifically described later) closed at one end, were bored on an ordinary horizontal boring mill, single spindle; the only special fitting being a steadiment bracket bolted to the table close to the open cylinder end, to give the single boring bar all possible support. In June, 1903, the Winton production was twelve cylinders per day from this one boring mill, with one man in charge of it.

The Packard shops used a horizontal boring mill, and fitted everything in the most elaborate manner with no regard whatever to production cost, in the belief that the best that any machine shop could do was not good enough for the hard service demanded of a road wagon. Dodge Brothers, Detroit, who build the motors for the Ford wagon (a pair of 4x4-inch opposed cylinders) bored them one at a time on an engine lathe, fitted with very well designed and well built special boring arbors and fixtures, which will be described in detail, as the whole of the Ford motor construction is well to the front; Mr. Ford being an experienced steam engineer

and having begun early with the automobile motor.

So far as I have seen, the Beaman & Smith Company have made the most extended effort in cylinder boring machines for wagon driving, and have supplied all the special machines built by any machine-tool maker for the purpose.

In the Wilmerding Westinghouse shops there is an air-brake cylinder boring machine by Sellers which was built specially for that job; these air-brake cylinders are larger diameter and longer than any automobile cylinder, and my recollection is that I held my watch on the performance of this machine and that the time was only nine minutes for each cylinder. I was not permitted to describe this machine, and therefore have no photograph of it, but if I were called upon to bore many automobile cylinders I should ask William Sellers & Co. about that Wilmerding air cylinder boring machine.

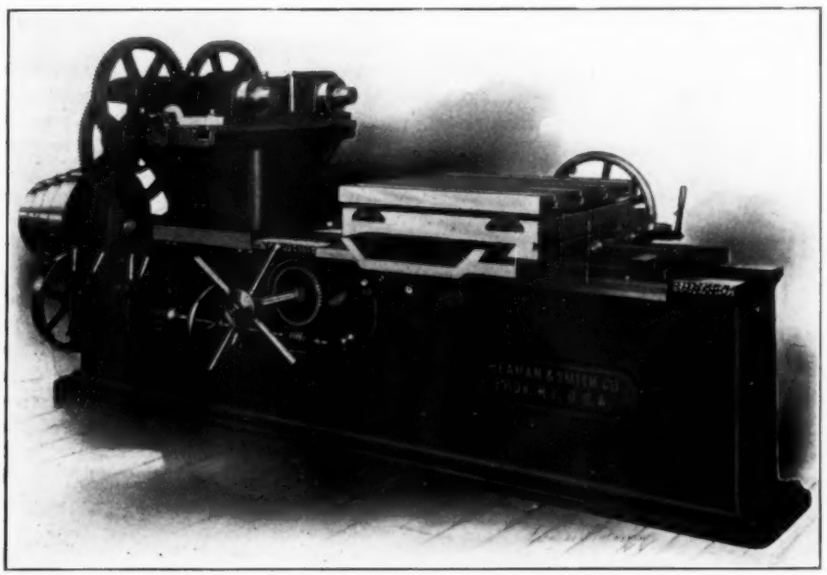


FIG. 15. DUPLEX BORING MACHINE FOR AUTOMOBILE CYLINDERS.

John Johnston, of Potter & Johnston, when he and I were shopmates in the Pratt & Whitney drawing room, did some work on hydraulic elevator cylinder boring for the Crane Company, Chicago, and though I may be wrong, as it was long ago, I think he succeeded in boring those cylinders (larger in diameter than any automobile cylinder) at the rate of two inches of length per minute.

As for the work of Beaman & Smith, it speaks for itself, as shown in the four illustrations which are given herewith. These machines, though of the same general character, as might be expected since they are all designed by Mr. Smith for the same general purpose, are quite varied in form, and will serve to show automobile constructors what has been done in this direction, and what may be expected in the future.

If my recollections are not greatly in error, similar jobs to automobile cylinder boring have been done in less time than any actual automobile work yet seen by me in the cylinder boring way.

Beaman & Smith say that they did not design the Oldsmobile cylinder boring fixtures, and in this connection remark that, although their work is very largely special machine tools, in which they make original designs to suit work as shown by blueprints furnished by their customers, they have always avoided making fixtures and tools if it was possible, inasmuch as no two toolmakers' ideas of jigs and fixtures agree, and superintendents and foremen are always better satisfied with their own productions in this line than with any others.

In corroboration I can say that at one large automobile shop, where there was a vast amount of jig drilling and none of the jigs impressed me as being strikingly original, or remarkably well adapted to their purpose, I was told that I might describe everything else in print, but must not disclose any of the jig practice, which was evidently regarded as something too good to give away.

Of course the finality is to avoid the use of jigs for all boring and drilling, depending on the actual axes of revolution of the tool carrying spindles for the cut locations, as is now done in some lines of extensive manufacture, but not, so far as I have seen, in any automobile shop as yet.

Fig. 12 is a triplex cylinder boring machine which was built by Beaman & Smith for the Automobile Company of America.

Spindle centers, 5⅝ inches; spindle centers to table, 8 inches; main cone for 3¼-inch belt on 15¼-inch, 17-inch and 18¾-inch step diameters; ratio of gearing, 24 to 1; spindle speeds, 14, 16⅔ and 20½ revolutions per minute; table travel, 35 inches; automatic feeds, 7½, 15, 30 and 60 turns per inch travel.

Fig. 13 is a duplex machine built by the same builders and sold through a dealer for some automobile maker whose name is not known.

Spindle centers, 4 to 8 inches; driving cone for 3½-inch belt on 14-, 16-, 18- and 20-inch step diameters; ratio of gearing, 15⅓ to 1 for 4-inch centers; spindle speeds, 13.8, 17½, 24¼ and 28 revolutions per minute; ratio of gearing, 22½ to 1 for 8-inch centers; spindle speeds, 9.4, 11.8, 15, and 19 revolutions per minute; table, 20x28 inches; table feed, 4, 8, 16 and 32 turns per inch of travel.

Fig. 14 is a duplex machine built for the Buffalo Gasoline Motor Company.

Spindle centers, 8 to 16 inches; spindle centers to table, 14 inches; main cone for 3½-inch belt on 14-, 16-, 18- and 20-inch steps; ratio of gearing, 36 to 1; cross table, 16x36 inches, and has 15-inch cross adjustment; table feed toward spindles, 28 inches.

Fig. 15 is a somewhat differently arranged duplex machine built for the Searchmont Automobile Company, and fitted for milling as well as boring.

Spindle centers, 16 to 21 inches; revolving table, 28 inches diameter; distance from revolving table to spindle centers, 11 inches; main cone is for 3½-inch belt on 14-, 16-, 18- and 20-inch steps; ratio of gearing to spindles, 9 to 1; speed of spindles, 57, 45, 35½ and 28 turns per minute; main saddle has 28-inch automatic feed toward spindles, at the rate of ¼, ⅛, 1-16 and 1-32 inch per rotation of spindle; cross saddle has 13-inch automatic feed crosswise of spindles from 2 to 8 inches per minute at any spindle speed.

Machining Gear Blanks in the Lathe.

BY FRANK B. KLEINHANS.

By properly fitting up a lathe turret for special work, one can frequently turn out such work more quickly than on a regular turret lathe. Especially useful is a turret drilling attachment for many lathe operations. The general arrangement of such an attachment is shown in Fig. 1, where *A* is the hexagonal turret which is arranged with power feed, and *B* a bevel gear box bolted to one face of the turret. The spindle in *B* is driven by means of universal joints and telescopic shaft from gear box *C* which is attached to some form of variable speed countershaft in order that the speed of the drill may be varied to suit the work. As a rule, we can find room for this countershaft, as it comes over the rear end of the bed, and does not interfere with the driving mechanism of the lathe itself. As the turret is shifted back and forth to suit the work and is also rotated, the countershaft should be placed about midway of the extreme positions of the turret.

A plan view of a lathe fitted up with this attachment is shown in Fig. 2, its spindle being provided in this case with a taper socket to receive a boring bar *D*. The gear caught in the jaws of the chuck has a cored hole and the first operation is performed with a four-lip drill which is allowed to

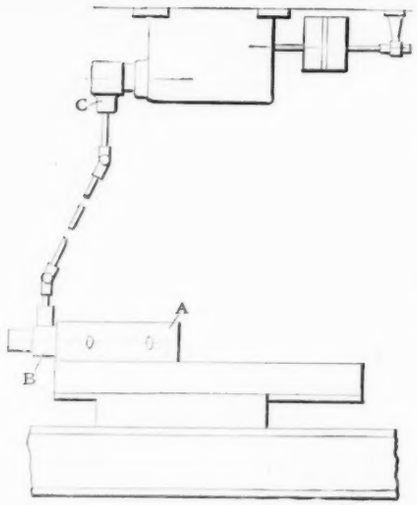


FIG. 1. TURRET DRILLING ATTACHMENT.

take its own course as it is fed through the rough hole to remove the scale and prepare the way for the boring operation. The turret is then run back and the boring bar brought into position, the outer end passing through the hole and entering the supporting bushing *E*, which fits in the

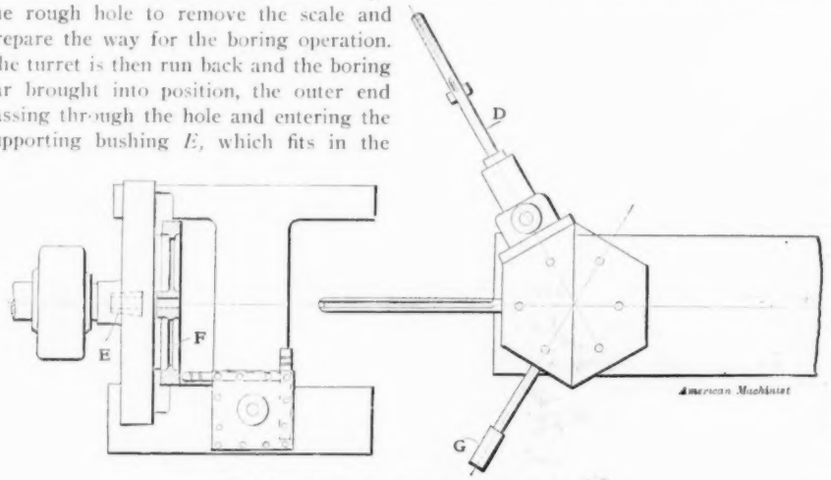


FIG. 2. PLAN OF TURRET AND TOOLS.

taper portion of the spindle bore. The turret is now fed up until the cutter comes up against the work. As the lathe spindle runs forward at the proper speed for turning, the drilling attachment is run backward so as to give the bar the proper speed. This bar is made of machine steel, and the outer end, which is provided with a spiral groove serving as an oil channel, is case-hardened and ground; the cutter is held by a key, as shown, the diameter being ground to suit requirements.

While the hole in the gear is thus being machined, the outer face *F* is being faced off with a tool in the post on the carriage, the latter being brought up against a stop in the bed. The turret tool-post is then swiveled around and a finishing cut taken off with another tool. By this time the operation in the bore is finished, so the reamer *G* is brought into line and the hole reamed out true, after which it is tested with a standard plug. The reamer is usually provided with some means of adjustment so as to be able to produce the exact fit required. The piece is now taken out of the lathe. After all the gears have been bored and faced off in this manner, they are key-seated and are then ready for the operation shown in Fig. 3, where they are slipped on an arbor *H* to be faced off on the other side. When the gears are small, a key *I* does the driving; when they are large, the keyway is omitted and a pin *J* against an arm used as a driver. The turret tool-post is brought up against a stop and a roughing cut taken with tool *K*, tool *L* then taking the finishing cut. The lathe being speeded up, tools *M* and *N* are brought up against their respective stops and the hub is finished.

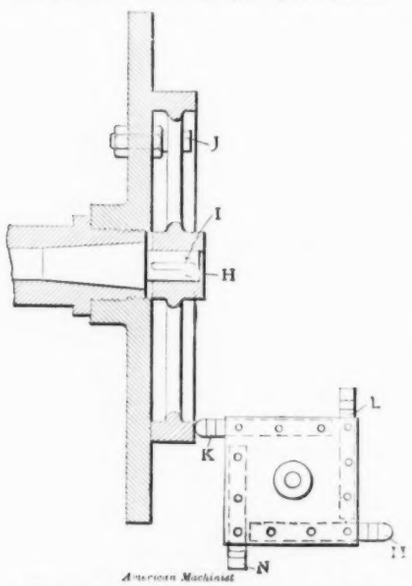


FIG. 3. FINISHING THE GEAR BLANK.

The drilling attachment for the turret not only allows us to turn out a great many more gears than we could otherwise, but also enables us to make holes in these gears dead true—which is a difficult thing to do without the attachment. There are many other cases where the device can be used to advantage; thus on a screw machine where we are making collars, etc., a water drill is used in place of the boring bar in order to remove the stock from the center of the bar. The spindle of the attachment being hollow, the necessary connection can be made so as to use the water drill whenever desirable. In boring steel gears a flow of water is kept on the cutter from a pipe near the face-plate.

Letters From Practical Men.

The Speed of Grindstones.

Editor American Machinist:

I wish to state for the benefit of Maurice E. Unwin (page 57) that 6-foot grindstones are regularly run at a peripheral speed of 3,300 feet per minute in the grinding department of the shop where I am employed. There are eighteen machines using stones of this size and running at this speed, and during the eleven years of my employment there, only two stones have burst, and in both cases the stones were defective. All the stones used are from Ohio quarries. O. B.

Locating Another Knock.

Editor American Machinist:

At page 1530, Vol. 26, a writer told about "Locating a Knock." He seemed to have been somewhat chagrined to find his trouble was caused by a loose wheel-key, after he had been to the trouble of scraping his brasses. An idea struck me at the time to reply to this, but it slipped my mind until the other day when I was looking over my back numbers of the AMERICAN MACHINIST (which I often do). I once worked in a shop where high-speed steam engines were built in sizes from 2 to 300 horse-power. In this shop all the engines were run and tested by an expert engineer, and after he pronounced them all right the superintendent came in and took cards and also looked them over himself. Now, in testing one there was a thump of a very decided kind which they both thought to be in the crosshead-pin. They had mills which had been made to fit in the connection rod in place of the brasses to true both the crank and crosshead pins so that they would be perfectly in line; they used these, but the thump was still there. Then they had a new set of piston rings fitted, and she thumped just the same. Then a new piston with no better results. They used a piston valve in their engines with the valve-case and steam-chest cast in one piece, and bolted to the cylinder; so next they put in a new valve which did not better it any. Next they put on a new steam chest, but it was just the same. They then made an examination of the cylinder and found about midway of the bore a very small ridge which could scarcely be seen or felt, evidently caused by the boring mill being stopped while taking the finishing cut either over night or at noon. The cylinder was rebored and the thump disappeared. Now, if two experts get fooled at the same time in this way, you can not wonder that others do once in a while.

MACHINIST.

Correcting Blueprints—An Indicator for the Lathe—Holding Work in the Miller or Shaper Vise.

Editor American Machinist:

Mr. L. O. Danse at page 1834, Vol. 26, wants to hear from draftsmen in regard to changing blueprints. I first apply the prepared erasing fluid until I have a white surface and then use the waterproof ink for making the change. In so doing I have the white surface to work on instead of the blue, as Mr. Danse suggests.

Figs. 1 and 2 show an indicator for centering work on the face-plate of the lathe. By placing the spring, Fig. 2, in a boring tool holder and then hooking the indicator point *A* into the center *B* in the spring, the ring falls over the spring and forms a simple universal joint. The one shown is of a special light construction which obviates all vibration. The work can readily be centered to less than 0.001 inch. It is made in two pieces, as shown, to go in the tool box easily.

Fig. 3 shows a good way of holding work tight on the parallels in the miller or shaper vise. *C* is the work to be machined, *D* the parallels and *E* a strip with edges beveled as shown. The more you tighten the firmer it rests on the parallels. Care must be taken to have the bevel right or the piece will not hold; but if made with an angle of 5 degrees it will hold against the heaviest cuts. E. S. C.

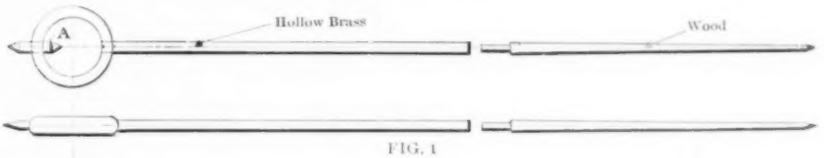


FIG. 1

FIG. 2

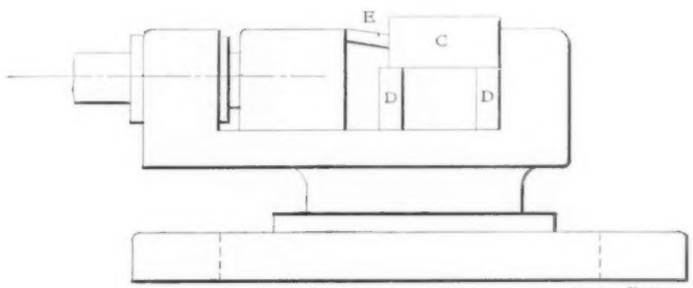


FIG. 3

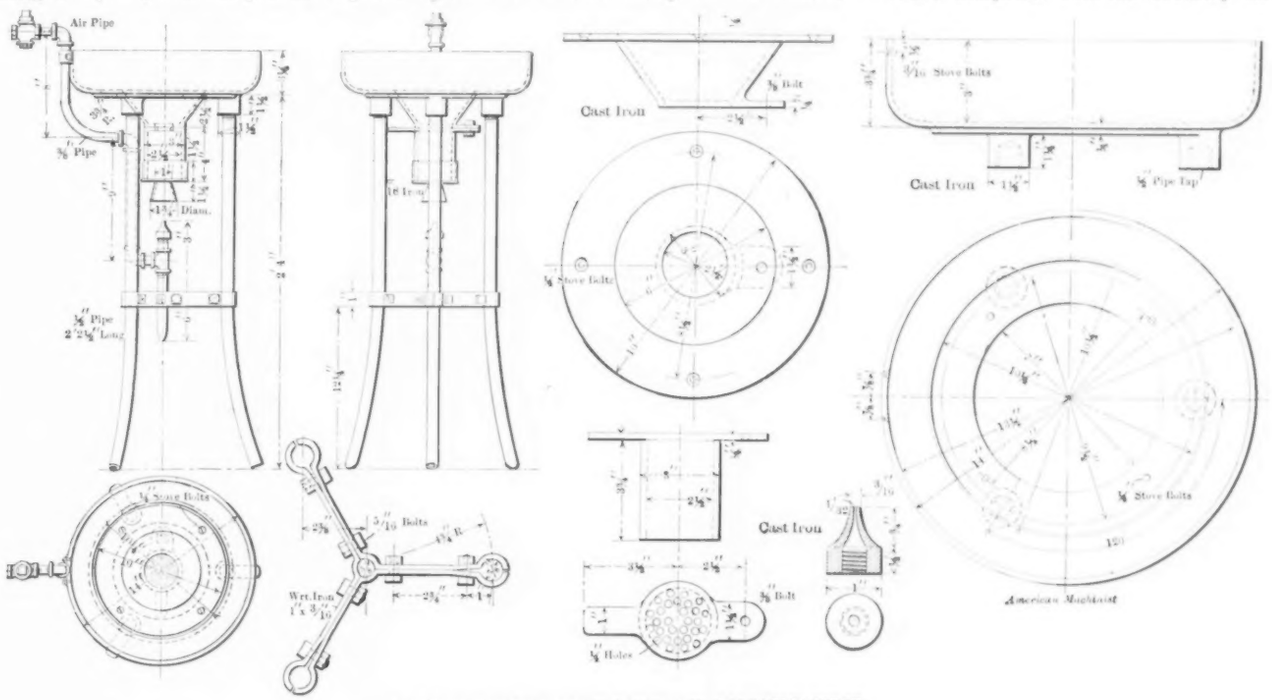
INDICATOR FOR THE LATHE—HOLDING WORK IN THE MILLER VISE.

A Light Weight Compressed Air Portable Forge.

Editor American Machinist:

The drawing shows a portable forge, designed by me, that has proven very efficient in practical service. It is large enough for heating boiler and structural iron work rivets, and at the same is very light and durable. It is fitted with a compressed air blast inducer, the jet having an injector action on the surrounding free air, thus forcing it up into the fire. By means of the air cock shown, the blast can be regulated as desired, and a uniform pressure produced, thus insuring an even and steady heat. The forge being light, weighing less than 40 pounds, is easily transported and is in no way clumsy, its three legs permit it to rest firmly on an uneven surface, the fire-pot is easily removed, and the grate or tuyere casting allows the fire to be cleaned from underneath. It is free from moving parts, ratchets, levers, etc., and is about as light as economical design will allow. Its construction requires 25 pounds of cast iron, 6 feet 7½ inches of ½-inch pipe, 2 feet 6 inches of ⅜-inch pipe, three ⅜-inch elbows, one ⅜-inch T, one ⅜-inch stop cock, one brass air nozzle, 2 feet 9½ inches of 1x7/16 inch wrought iron, seven ⅜-inch machine bolts, and six stove bolts.

When compared with the ordinary fan the air jet is about one-twenty-fifth as efficient for the production of blast at a given pressure. Experiments have shown that 1 cubic foot of compressed air will



A LIGHT WEIGHT COMPRESSED AIR PORTABLE FORGE.

produce 6.53 cubic feet of blast at a pressure of 1.85 ounces, the air pressure being 100 pounds per square inch. This inefficiency of the air jet as a blast inducer is largely offset by the even blast maintained, thus increasing even heating and greater output over the hand operated fan blast forge. It is further offset by the resulting portability of the forge and a minimum cost for repairs. N. C. H.

A Turret for the Lathe Cross-Slide.

Editor American Machinist:

In looking over some of my old notes and sketches, I find some relating to a turret which I designed and had fitted to many of the lathes in our shop. Thinking the subject may be of interest and may be profitable to some of your readers, I am sending you the drawings for the smallest size we built, namely, a 6-inch turret.

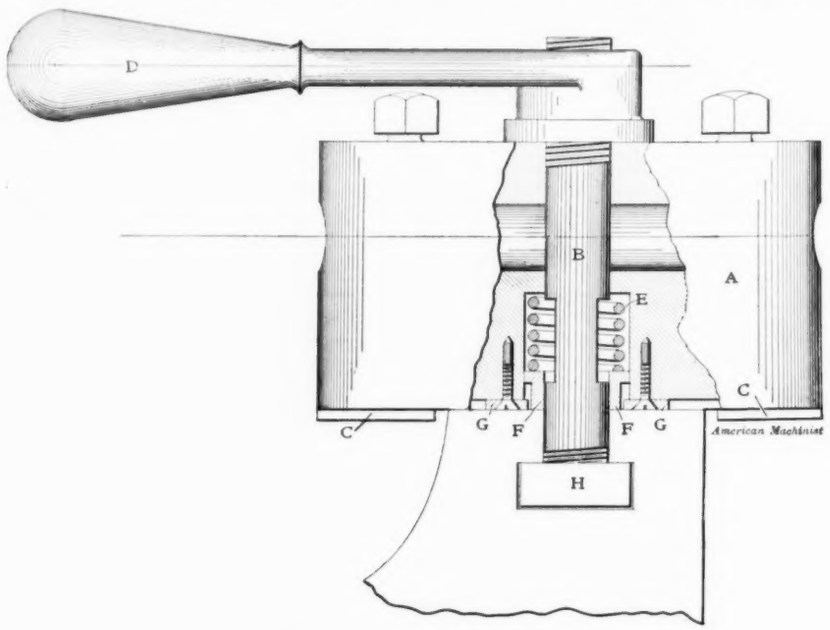


FIG. 1. TURRET ASSEMBLED.

The tool is simple and efficient, and can be built of almost any size, the tool-post T-slot determining the majority of the dimensions in the different sizes.

When in operation, the turret *A*, Fig. 1, is firmly held by the stud *B* against the tool block of the lathe. The movement of the turret about the stud is gaged by the pieces *C*, which are hardened steel blocks set into slots milled precisely at right angles to one another in the turret bottom. These pieces project and fit snugly into the T-slot in the tool blocks.

When the turret is to be rotated the handle *D* is loosened, thereby allowing the spring *E* to raise the turret until blocks *C* clear the casting below. The turret may then be swung round to the desired position and again clamped in place with the pieces *C* in the slots.

To prevent excessive movement of the spring *E*, the collar *F* is used. In operation the spring will force the turret upward, when the handle is released, until the flange on the collar is struck by the pieces *G* set into the milled slots, and flush with the turret bottom. This collar also forms a good seat for the spring, and prevents its being lost when the turret is not in use.

As will be seen, the stud *B* is threaded at both ends and flattened about midway. The lower thread, which fits the rectangular nut *H*, is finer than the upper which fits the clamping handle. To place the stud in position it is slipped into the T-slot and then screwed tightly through its nut *H*, thereby binding it securely in place in the slot. This enables one to use a stop on the lathe bed for the production of duplicate work, as the position of the stud or turret center is not affected by the moving of the handle *D*. The fine pitch of the lower thread prevents the stud from becoming loose when the handle is turned to release the turret.

In order to clear large work I used but four tools in my turrets, although I see no reason why five or six could not be used. The holes of course should be bored with the turret in position on the lathe for which it was made. I strapped mine fast to the carriage and used first a drill and then ran a cut through with a boring bar running on centers. The lathe cross-slide should be carefully marked and then fastened in place; the mark will enable one to set the turret properly, in the future, without trouble.

The position of the clamping handle, as I show it in the assembled view, would be inconvenient for the operator. We faced the handle until, when tightened on the turret, it pointed toward the tailstock. There it was out of the way, and the operator could use his right hand to manipulate it.

These turrets are remarkably stiff, as the cross-slide gibs can all be tightened when using; and, unless the spring breaks, they are not apt to get out of order. At any rate they gave us satisfaction, and I should like to hear of others using them.

TOOLMAKER.

Shaper Fixture for Rod Brasses.

Editor American Machinist:

The sketch shows a device used on the shaper when planing rod brasses. This

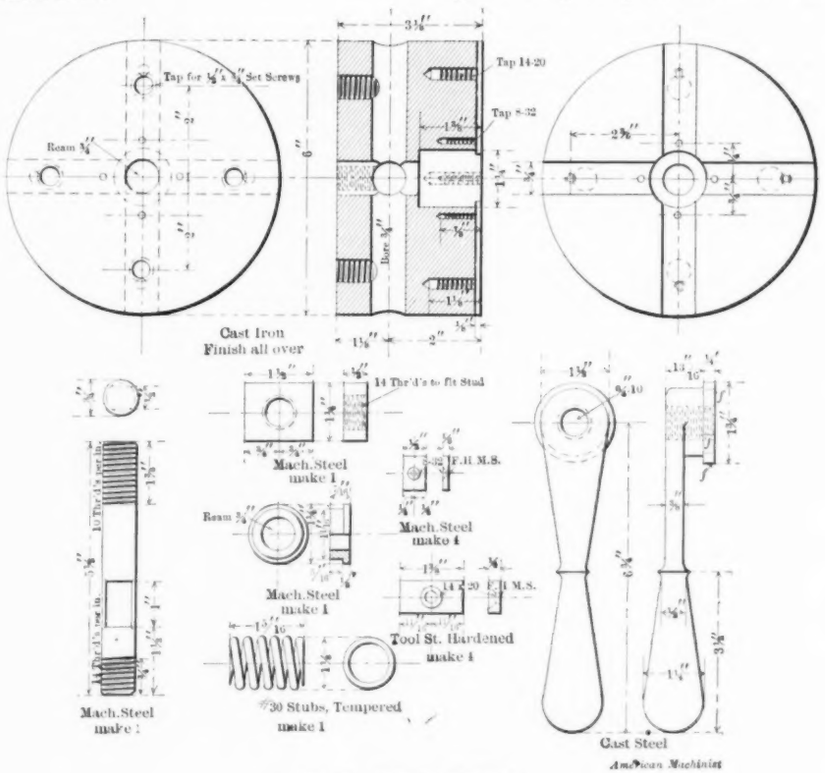
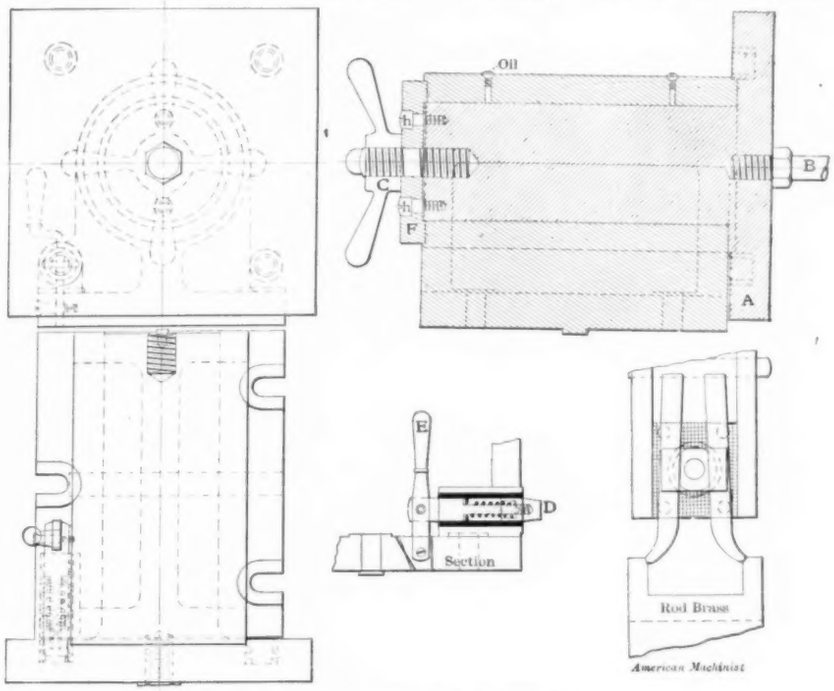


FIG. 2. TURRET DETAILS.

fixture is bolted to the shaper with *A* overhanging the table, so that it may be free to turn without coming in contact with the table. A rib on the base of the main casting fits the slot in the table, locating it true with the machine. The brasses are sweated together in the usual manner, then one face is planed and the brass is bolted to plate *A* with an ordinary flat strap and stud *B*. This plate is clamped to the main casting by handwheel *C*. Plate *A* has four hardened taper bushings located 90 degrees apart and equidistant from the center. The taper pin *D* is held in place by a stiff spring as shown, and withdrawn by lever *E*. Plate *A*, which has a spindle turned to fit the casting, is let over enough to prevent chips from interfering with it. Washer *F*, at the other end, is let into the casting for the same purpose. The two shouldered screws *h h* hold this washer in position, so preventing unnecessary end motion to the spindle.

The advantage of this fixture over that most commonly in use, the angle plate, even when a single tool is used, is that there is not so much changing of tools, as the work is changed instead, or instantly set in either of the four positions. The use of the square for setting the brass is also dispensed with. At the lower right-hand corner is shown a brass being rough planed with two tools. In doing this the shaper is set at a little longer stroke than if one tool were used with the head set over. The tools are lifted by hand at the end of each stroke to prevent them dragging too heavily on the return stroke or catching on the brass on the forward stroke before they drop back into their cutting positions. A bolt is used with a strap on the shaper head in place of the tool-post when using two tools for this or any other purpose.

A. L. M.



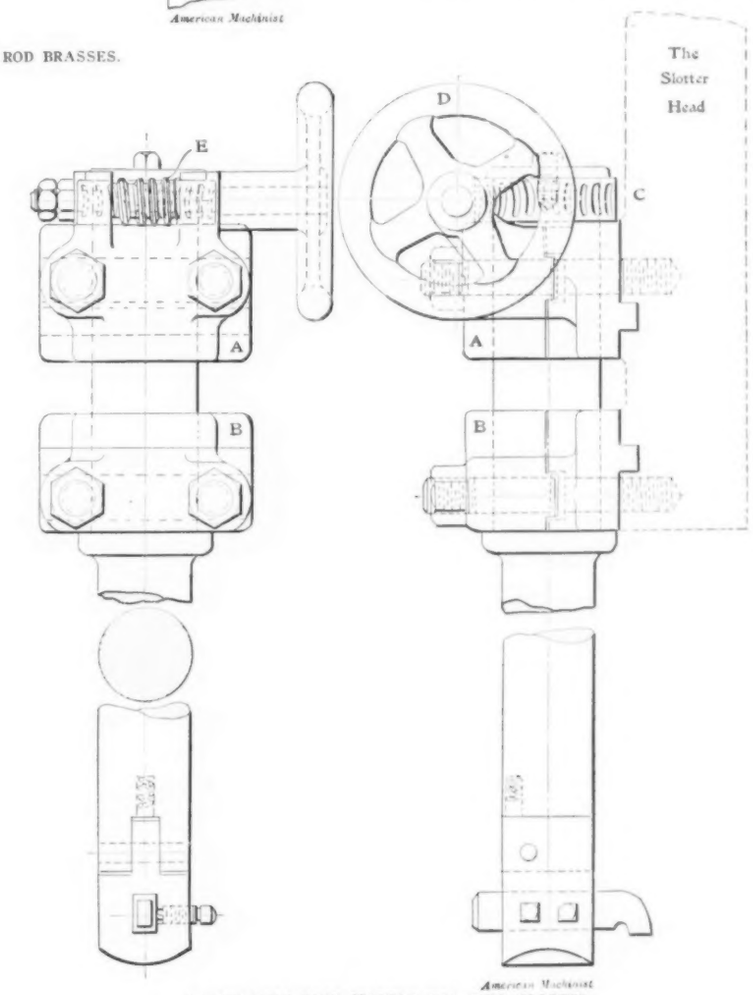
SHAPER FIXTURE FOR ROD BRASSES.

A Rotating Tool-Holder for the Slotter.

Editor American Machinist:

A rotating tool-holder for the slotter may be appreciated by some who have fillets to cut in castings of some sort that will not swing in the slotter frame, or on some long work, as locomotive side frames which are slotted on the three head slotting machine. This tool costs very little to rig up and performs its work very satisfactorily. The firm I am with has recently purchased several single head and three head slotters, and as soon as they reached the shop we took off the heads of the machines and fitted to them our bearing boxes *A* and *B* shown in the drawing. On the top of the bar is keyed a worm wheel *C* which is operated by the hand wheel *D* and worm *E*. I think no further explanation is necessary.

T. B. BURNITE.



A ROTATING TOOL-HOLDER FOR THE SLOTTER.

High-Speed Steels for Finishing Tools.

Editor American Machinist:

Lately I have read in the AMERICAN MACHINIST several articles both for and against high-speed steels for finishing. I have had considerable experience with nearly all of these steels, as we have given them an extensive test to determine which was the best for our own use, and we are now using them exclusively for lathe tools on both hard and soft steel and cast iron. We find that while they are not as good for facing work as a good tempered steel,

in turning a finish chip they will stand a very high speed and cut both smooth and straight—in fact, will not wear at the point as much as the ordinary tempered steel in proportion to the speed used. I have turned steel pieces (of 35 points carbon) 5 feet long, 4½ inches diameter at a surface speed of 175 feet, removing 1-32 of an inch stock; the surface left being smoooth enough so that .002 inch would remove the tool marks, the work tapering not more than .001 of an inch and the tool standing up well enough to turn twenty pieces. On the same work the regular tempered steel would not turn more than eight or ten pieces, as smooth and straight at a surface speed of 45 feet per minute. This was with the steel that also gave the best results on heavy roughing cuts. In finishing crucible steel I find we can run our lathes two belt speeds faster than when using tempered steel, and our work is as smooth and nearer straight, and the tool will stand up about twice is long; but when facing cast iron or facing steel with a side tool the tempered steel is better, as the high-speed steels are inclined to scratch owing to the fine edge crumbling so as to resemble saw teeth. On very hard steel the high-speed steel will in finishing give quite a smooth surface where the other steel would not stand at all. We have also found high-speed steel very useful for thread tools, the threads produced being smooth, and the tools lasting about three times as long as the usual tool. For example, a thread tool made of Novo steel cut before being entirely worn out 500 threads, while a tempered steel tool on the same thread cut only 150 before being worn out.

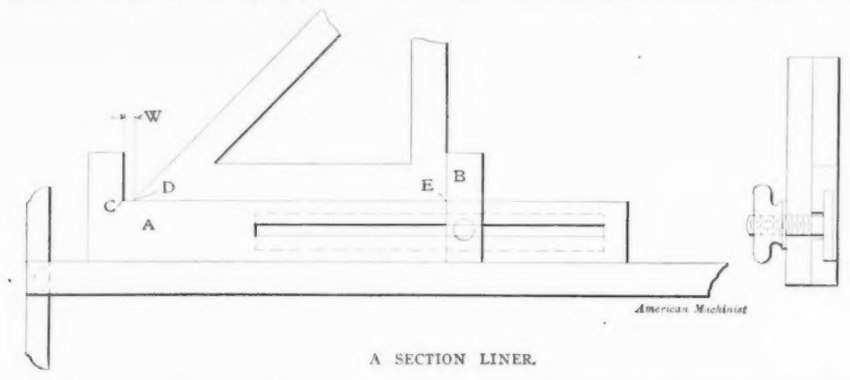
MACHINIST.

A Section Liner.

Editor American Machinist:

I send you a sketch of a section liner which I had made for our offices, and find it practical, reliable, quick-acting and, so to say, universal. It is made of transparent celluloid, ⅛ inch thick, though hard rubber will answer. A 45-degree triangle is used and worked as follows:

First set on piece *A* the movable slide *B* to the length of the base of the triangle plus the width of the spacing *W* of the



A SECTION LINER.

section lines needed, and clamp it. Draw the first line when the point *C* is in contact with point *D*, then move the triangle to point *E* and piece *A* to point *D*. Two lines can be drawn now by shifting triangle. Repeat until the sectioning is completed.

I have not given any dimensions, as this little tool should be made to fill the requirements of each individual. The construction is self-evident from the sketch. I would like to add that piece *A* slides along the T-square as shown, and that all movements of the liner can be easily made with one hand. A little practice will produce very rapid work.

CHIEF DRAFTSMAN.

Special Tools for a Special Pulley Job.

Editor American Machinist:

The accompanying drawing gives a sectional view of a 10x8-inch Nelson loose pulley. This pulley has certain peculiarities which, though necessary to its successful working, do not render the making of it any easier, and after briefly describing it I would like to illustrate part of the tools we made to facilitate making it right and in good time.

From the drawing, Fig. 1, it will be

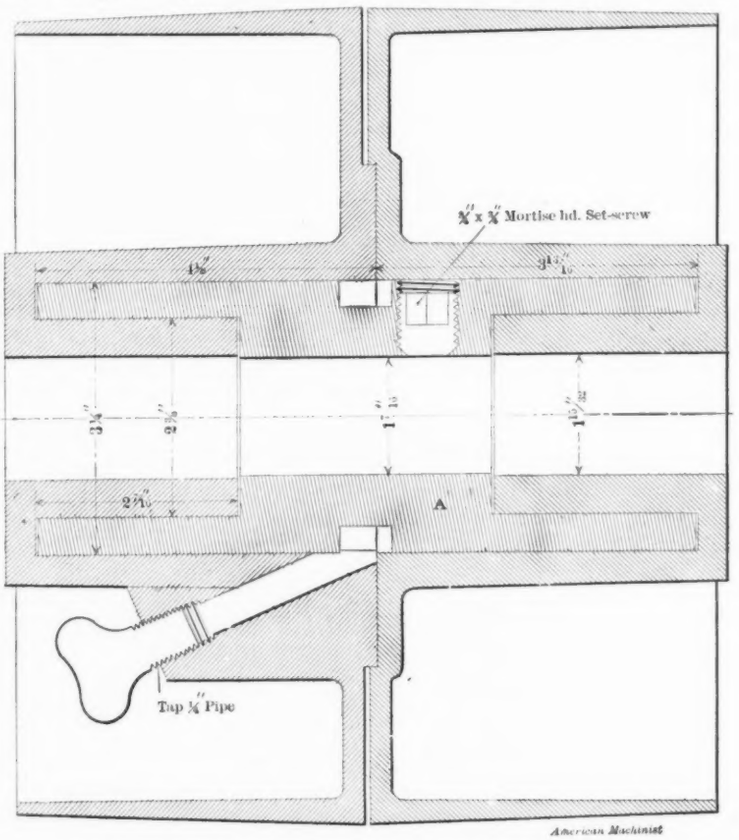


FIG. 1. A LOOSE PULLEY REQUIRING ACCURATE MACHINE WORK.

noted that this pulley does not run on the shaft but on a sleeve *A*, which is setscrewed to the shaft and provides the bearing for the pulley, not only on its periphery, but also in both ends into which the "inner hub" of each half of the pulley enters and bears. The object of this arrangement, it will be plain, is to provide an extremely large amount of bearing area, the theory being that with so great an amount of bearing surface the tension of the belt cannot force the oil from between the surfaces and that consequently a much thicker film of oil will exist, giving a sort of floating action.

Nothing except actual results has established my faith in this arrangement as much as the statement made by Chas. T. Porter in his "Engineering Reminiscences" in the AMERICAN MACHINIST, where he says at page 870, Vol. 26, that "two flat cast-iron surfaces, perfectly true and incapable of deflection, with the pressure equally distributed over a sufficient area, protected from dirt and properly lubricated, will never have the clean film of oil between them broken or even varied in thickness, and will run together without wear, perpetually and at any speed whatever."

Some time before I read this, and also Mr. Porter's statement in the same "chapter," that he had known crossheads which

had been running at rapid speeds from twenty to thirty years and the scraping marks still visible, the patentee of the pulley had been telling me that they wouldn't wear out and that, though he guaranteed them for five years, he had never had one returned to him, and I smiled that particular smile that meant "It's impolite to call anyone a liar, so I won't do it."

To return to the pulley; it must be accurately made, for it will be seen that a very little inaccuracy will put part of the bearing surface out of commission. Special tools have been made for turning the spaces between the inner hub and the bore for the sleeves in the two halves; but, while these tools are doing good work, they are not quick enough to suit me, and when I have made the changes planned you will hear from me again. The work these tools have to do is not a "snap." Notice that the bore for the sleeve is 3¼ inches and the diameter of the inner hub 2⅜ inches, leaving an annular groove 7-16 inch wide and 2 7-16 deep to be cut in solid metal, while the beginning of this 2 7-16 on the male half is 1½ inches below the surface.

FIG. 2. REVERSIBLE CHUCK FOR BORING THE SLEEVE.

FIG. 3. DRILLING OIL HOLES IN PULLEYS.

The sleeves have been provided for by the special chuck shown in Fig. 2. For a 16-inch Davis lathe a reversible chuck held in a special face-plate was made. The sleeves are held in this chuck by the screws, these being all the same length to enable the invisible rear end of the sleeve to be trued without difficulty. After being bored for the shaft and counterbored, the crane is swung forward and spring plungers in the yoke or bail slip into holes diametrally opposite in the chuck. The screws then being removed, the chuck is reversed by turning it over (in a vertical plane to allow the chips to drop out), and it is again clamped to the face-plate in which it is accurately fitted. The spring plungers are withdrawn, the crane is swung aside and the other end is finished. The chuck proper is very rigid and the tight setting of the twelve 1-inch set-screws does not distort it sufficiently to affect its fit in the face-plate, and very true work is the result.

The crane rests on one steel ball in the center and the bail hangs on a ball bearing. A peculiar ball-and-socket suspension at the top of the crane makes adjustment vertically very easy, and the whole may be lifted off bodily without loosening or removing a screw. This chuck handles sleeves up to 9 inches long and 4 inches diameter.

The fixture for drilling the oil holes is shown in Fig. 3. It may not be considered necessary to make a special fixture for so simple an operation, but, as these pulleys are made with a great variety of diameters, widths and bores, we had considerable trouble in tipping them to the right angle, so that the oil hole would come out where it should, just opposite the groove in the sleeve, which serves as an oil chamber. In the fixture the two lugs in which the lower end of the tilting table rests and fulcrums are permanently attached to the drill platen. The tilting table has a V at its lower end and at the other a flat bar is hinged, which passes through a flat slotted plate and through one of the slots in the platen. This flat bar has a numbered hole for each degree of angle and a pin, fastened by a chain to the slotted plate, may be inserted in any one of these holes to support the table at the desired angle.

A schedule hangs near by giving the number of the hole in which the pin must be inserted for any diameter and face of loose pulley so that mistakes, after the right angle has been found, are scarcely possible. Being used occasionally several times each day, this fixture is not kept in the tool-room, but hangs next to the only drill press on which it can be used.

The tools here shown and described are not incapable of being improved. For instance, the sleeves could be made much quicker in a machine having a bed with a rotating chuck in the center of its length and tools operating on both ends of the sleeve simultaneously, but the expense of building such a tool is not now warranted. As before stated, there is such a great variety of sizes of these pulleys made, on account of the different combinations of diameter, face and bore, that making any one size in large numbers is out of the question. Builders of those excellent semi-automatic turret lathes now so much used have written us, recommending their ma-

chines for this work, but immediately upon explanation of the requirements they have retreated. CORNEIL RIDDERHOF.

Calculations for Hydraulic Punching and Shearing Machines—Finding the Moment of Inertia.

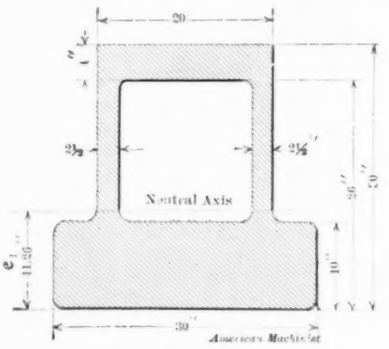
Editor American Machinist:

The articles describing the hydraulic punching and shearing machine, published at pages 1757 and 1786, Vol. 26, contained much of interest to your readers, who do not, as a rule, have the privilege of seeing a machine so clearly illustrated and minutely described. One feature especially was very commendable—the description of the calculations of power, etc., in connection with the designing of the machine. It happened that when the second article, which contained this matter, appeared I was engaged on somewhat similar calculations, and wished to compare notes with Mr. Herzberg as to his method of arriving at the stresses on the frame at the throat. The result of this comparison was that differences became apparent, and it is in order to seek light on those differences that this is written.

Mr. Herzberg states, to begin with, that it was desired not to exceed 4,800 pounds per square inch for the stress at the most strained points. If this is meant for tensile stress, is it not rather high for this class of work? The most common limit appears to be about 2,600 pounds, some designers going as high as 3,000 pounds per square inch. Passing this, I note that the moment of resistance of the section was calculated and also determined graphically, but without taking into consideration the reinforcements at the outside of the throat, the effect of these in reducing the stress being afterwards stated as about 10 per cent. Would it not have been more satisfactory to calculate the moment of inertia of the section and the position of the neutral axis from the dimensions of the actual casting?

The calculation of the moment of inertia is a rather tedious operation, and any method of performing it, that eliminates chances of confusion and error, is to be preferred. After experience with several methods of calculating this quantity I have found Heppel's by far the most satisfactory. This method, which will be used a little later, gives precisely the same results that Mr. Herzberg arrives at for the value of I and for the position of the neutral axis in the section without reinforcements.

We come now to two points where there is quite a divergence between Mr. Herzberg and other designers' calculations. He takes the bending moment of the force tending to rupture the section, as PL, in which P is the pressure on the punching piston and L the depth of the throat. This moment should be $P\ (L + e_1)$, in which e_1 is the distance of the neutral axis from the edge of the section forming the back of the throat. The second point is where Mr. Herzberg neglects to consider the uniformly distributed tensile stress produced by the upward pressure of the load. This tensile stress must be added to that due to moment of force P at points in front of the neutral axis, while at points back of the neutral axis this tensile stress will lessen the compressive stress due to moment of force P. Taking A as the area of the section this uniformly distributed tensile stress will be $\frac{P}{A}$.



DIMENSIONS OF SECTION.

For the sake of comparison, let us take the section without the reinforcements as given by Mr. Herzberg and calculate the stresses produced by the load. The same notation that he used will be employed as far as it can be.

The throat L being 26 inches deep, the load P 356,000 pounds and the distance e_1 of the neutral axis from the edge of the section 13 inches, the bending moment is $356{,}000 \times 39 = 13{,}884{,}000$ inch-pounds. The moment of resistance of the section:

$$M = \frac{I}{e_1} = \frac{36{,}280}{13} = 2{,}790,$$

as given by Mr. Herzberg. The tensile stress at the edge of the section due to the moment of force P is

$$\frac{13{,}884{,}000}{2{,}790} = 4{,}976 \text{ pounds.}$$

The tensile stress uniformly distributed due to P is equal to

$$\frac{P}{A} = \frac{35{,}600}{360} = 988 \text{ pounds.}$$

The total tensile stress at the edge of section is thus 5,964 pounds per square inch instead of 3,310 pounds as given.

Now let us take the matter up as the frame was actually made, namely, with the reinforcements. As stated above Heppel's method of calculating the moment of inertia and position of neutral axis will be used.

Let e_1 = distance of neutral axis from lower edge of section,
H = hight of any particles from lower edge of section,
B = breadth of section at any hight H,
Σ = sum,
$\triangle$ = difference,

then

$$I = \frac{\Sigma B \triangle (H^3)}{3} - A e_1^2,$$

$$A = \Sigma B \triangle H,$$

$$e_1 = \frac{\Sigma B \triangle (H)^2}{2A},$$

and we have the results given in the table from which

$$e_1 = \frac{10{,}360}{920} = 11.26,$$

$$I = \frac{301{,}360}{3} - 460 \times (11.26)^2 = 100{,}453 - 58{,}323 = 42{,}130.$$

The dimensions of this section are such as to make the above calculation an extremely simple one, but even with sizes in odd or fractional figures there is nothing formidable about the operation provided the slide rule is used.

$$\frac{I}{e_1} = \frac{42{,}130}{11.26} = 3{,}741.5,$$

$P\ (L + e_1) = 35{,}600 \times 37.26 = 13{,}264{,}560$ inch-pounds.

Tensile stress at edge of section due to moment of force P is equal to

$$\frac{13{,}264{,}560}{3{,}741.5} = 3{,}545 \text{ pounds.}$$

To this add $\frac{P}{A} = \frac{35{,}600}{460} = 773$ pounds, making maximum tensile stress 4,318 pounds per square inch.

H	H^2	H^3	$\triangle H$	$\triangle H^2$	$\triangle H^3$	B	$B\triangle H$	$B\triangle H^2$	$B\triangle H^3$
0	0	0							
			10	100	1,000	30	300	3,000	30,000
10	100	1,000							
			16	576	16,576	5	80	2,880	82,880
26	676	17,576							
			4	224	9,424	20	80	4,480	188,480
30	900	27,000							
							460	10,360	301,360
							$\Sigma B\triangle H = A$	$\Sigma B\triangle H^2$	$\Sigma B\triangle H^3$

RESULTS OF CALCULATIONS.

The maximum compressive stress can be found by a similar calculation—excepting that $\frac{P}{A}$ is deducted instead of added—to be 5,127 pounds per square inch, which is well within safe limits.

We thus see that the addition of the reinforcements reduces the stress on the extreme edge of the section from 5,964 pounds to 4,318 pounds per square inch, or 27.6 per cent. instead of 10 per cent., as stated, and so are really much more effect-

ive than supposed. Nothing has been said in regard to the two housings being rigidly bolted together. This must have the effect of giving the frame an advantage that it would not have otherwise, but it is doubtful whether it would be wise to make much allowance for it in calculating the stresses.

The foregoing has been written in the hope that it will bring some additional light on a subject that must be of interest to many, and if anyone has a word of criticism on what is stated here I will be glad to have it. WM. H. RAEBURN.

Dundas, Canada.

The New York Automobile Show.

As a city New York is the opposite of mechanical. It is benighted mechanically and it is therefore somewhat anomalous in a certain sense that a purely mechanical exhibition should be so successful as the various automobile shows have been, including the one just closed. And though there is a good deal of the sporty element in it yet and the most obtrusive feature of too many of the exhibits consisted of pert youths surrounded by clouds of cigarette smoke and who gave little or no evidence of knowing anything worth speaking of about the machines they were supposed to represent, yet on the whole there can be little doubt that the general public—that part of it that has heretofore bothered itself very little with such things—is enlightened not a little on purely mechanical matters by every such exhibition. Of course the ideas expressed by the ordinary business or professional man about the respective merits and demerits of different speed-changing devices, sparking plugs, clutches, equalizing gears, air-cooled and water-cooled cylinders, etc., are amusing enough, but it is surprising to note how often a man whose mechanical education has been derived entirely from his experience with automobiles shows an intelligent knowledge of their construction and of the nature and function of mechanical elements generally.

Superficially one automobile show is much like another, and the one just closed differed from the others that preceded it only in details here and there, the general tendency being upward in respect of quality, appointments, workmanship and prices; the latter being possible mainly by reason of the craze or fad element of the business which makes a man with plenty of money willing to part with most of it for the sake of gratifying his pride or being "in the swim." When by the lapse of time this feature of the business has been eliminated it will not of course be possible for manufacturers to get the public in large numbers to pay for the privilege of entering a building in which machines are exhibited and the doors will then be open, the same as they are now in Liberty street, where far more highly developed machinery is to be seen in abundance.

As has been the case with previous exhibitions, foreign cars, especially French cars, are much in evidence and, generally speaking, they are much more highly perfected than the American cars, and of course are also much more expensive—sold usually to people who don't need to care what a thing costs them so long as they get the thing which everybody is saying is the best or the makers of which have won the most races.

We can by no means mention all the interesting features of the exhibit, but a frame of the French car known as the Darracq is worthy of special attention. This is a frame which in shape is much like the one that has been used heretofore, but instead of being composed of a number of pieces of sheet steel riveted together it is electrically welded and is a beautiful piece of work. The steel is about ⅛ inch thick; the frame is, generally speaking, of the square U section with rounded corners and is 12 feet long, the sides being connected at the back and about the middle of the length of the car by cross girts, and there are two wings that are carried under the frame, one from each side and approaching each other beneath and which carry the engine. In other respects, too, the car is very well constructed indeed, and a feature which will be appreciated is a double connection by means of which when the clutch is withdrawn to stop the car the throttle is at the same time automatically closed sufficiently to prevent excessive racing of the engine; again throwing in the clutch opens the throttle to the point at which it stood before as fixed by the indexed lever above the steering wheel. The man in charge tells you of one of these cars which is being built to the order of the American manager of the business, which car will have engines aggregating 180 horse-power and with which it is intended to go after some of the cherished and hard-won speed records. There will be two sets of engines—one in front in about the usual position and the other at the rear, and this last can be switched into service in connection with the other whenever great speed is desired and power is wanted to attain it.

Among the American cars one of the most distinct novelties perhaps is the Phelps, the principal novel feature of which is that the engine rests upon a spring especially provided for that purpose just above the forward axle and independent of the springs which support the body. There is a gear transmission to the rear axle, and all the mechanism for this is enclosed within a cylindrical trunk which extends back from the engine to the equalizing gear and also is the "reach" or sole connection between the forward and rear axles. This construction makes it possible to easily raise the front of the body up (hinging upon the rear axle) so that the engine and all the mechanism and the bottom of the body, too, for that matter, are readily accessible—almost as much so as though the body were entirely removed from the chassis. The arms of the flywheel of this engine are made of the proper form to be utilized as fan blades and throw a blast of air over the engine to keep down its temperature.

A car which is likely to appeal to the mechanic especially, as well as to the driver, is the Matheson, the engine of which is, it seems to us, especially noticeable as a piece of mechanical engineering. The base and crank-case of the engine—which is of the vertical four-cylinder type—is cylindrical, the axis of this cylinder being of course horizontal. Bolted to suitable seats provided for the purpose are the four upright cylinders which, externally, are plain round cylindrical pieces, without bosses or projections of any kind. They are made open at both ends, and to their tops are bolted the valve chests which contain both valves, these castings also being practically symmetrical about their axes. Thus the trouble that arises from unequal expansion and contraction due to uneven heating of non-symmetrical cylinders and attachments is avoided with the attendant necessity for making the fit of the pistons looser than would otherwise be necessary, and there are no pockets or excessive clearance spaces. By taking off the nuts from the studs the valve casings may be lifted off and with them come the levers and rollers which rest upon the cams which are upon the valve cam shaft that is near the tops of the cylinders and at one side. In general neatness of design, accessibility, and in the proper proportioning of parts to limit the working pressures to proper figures the engine of this car is noteworthy. On the dashboard, in front of the driver, is a dial which shows at all times the cylinder in which the explosion has just taken place. When the car has been stopped, by turning the hand on another dial to the figure deduced from the reading of the first-named dial and pressing a button, the proper cylinder is fired and the engine starts. This has been done when the engine has been standing for as much as six days and for all ordinary stops is, it is declared, entirely to be depen'ed upon.

One of the surprises of the show is a touring car made by Olds, and the Franklin, of Syracuse, with its four air-cooled cylinders and high power in proportion to its weight, attracts much attention.

Hearing on the Metric Question.

The Committee on Coinage, Weights and Measures held on January 21 a hearing on the proposed metric legislation, at which hearing F. A. Halsey, representing the National Association of Manufacturers, and Mr. Dale, of Boston, argued against the proposed law

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The new alloy, magnalium, is being used largely in the manufacture of scientific instruments on account of its low specific gravity. An alloy containing 86 per cent. aluminum and 13 per cent. magnesium is about 2.5 specific gravity.

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The index to the last year's volume of the AMERICAN MACHINIST is being mailed to all who ask for it. If you wish a copy of it, send your name and address to either the New York or London office and it will be mailed free. Postal card will do.

The Civil Engineers and the Union Building.

Certain newspapers who relish a sensation connected with a prominent name have made the utmost possible use of the discussion that took place at the recent meeting of the American Society of Civil Engineers on the acceptance of Mr. Carnegie's gift of money for the erection of a union engineering building. Startling headlines appear over an account, which, after all, seems quite sane and reasonable, with the exception of the part contributed by Robert Cartwright, of Rochester, an ex-member of the American Society of Mechanical Engineers, and whose impressive and vociferous and detailed account of how he, Robert Cartwright, showed a young graduate engineer how to adjust the cross-hairs of his telescope, remains a vivid memory in the minds of all those members of the American Society of Mechanical Engineers who at the time were crowded into its small auditorium and therefore heard it. Mr. Cartwright seems to be saturated with the idea that the occupancy of the same building with the other and, in his opinion, far inferior societies, means a practical amalgamation of the Civils with those other and inferior societies. This he called a "Mormon marriage" and various other unpleasant things and generally indulged in oratorical hysterics in a way that must have very strongly reminded those members of the American Society of Mechanical Engineers that happened to be present of old times and happily past conditions. The indications are that the Civil Engineers will join in the occupancy and management of the new building, which it is now quite certain will be built in any event.

The "Average" Wage Earner and His Ambitions.

We have not seen a copy of John Mitchell's book on "Organized Labor" and do not therefore know just what there may be in it we should find to criticise, but we should think that the able editors who are tearing this book to pieces might find a more vulnerable passage than the one they seem to concentrate their heavy artillery upon. The statement referred to is as follows: "The average wage earner has made up his mind that he must remain a wage earner."

We are treated to columns of stuff to show that this cannot be true, and that if the average wage earner thinks any such thing as this he is a fool and does not know anything of his own situation. The latest example of a criticism of this kind we find in a certain railway contemporary which goes on to give instances of individuals who have risen from the ranks to positions of high commercial success, these being cited as proof that the average wage earner is entirely mistaken or that Mr. Mitchell does not know what he is talking about. It seems to us, however, that the examples cited simply prove that the individuals referred to who have climbed so high upon the ladder of success were not *average* wage earners. They were, in other words, superior wage earners—that is, those who had superior mental and physical equipment which enabled them to rise above the average. Plenty of employers of labor can be found who will be perfectly ready to say that the *average* wage earner has made up his mind that he must remain a wage earner. Indeed they complain bitterly of this, and say there is far too little ambition among workmen and that it is much too difficult to secure men who will take any interest in their work or who have any ambition in connection with it. In fact, it is not infrequent to hear empolyers say that they cannot find any men at all who will take an interest in the work and who exhibit the proper ambition. This is probably an exaggeration, but it is nevertheless true as a matter of common observation that the average man does expect that he must remain a wage earner and that it is only the man who is conscious of superior ability that expects to rise above the wage-earning class.

Our contemporaries go on to tell of the frightful things which will result from this conviction upon the part of the average wage earner. With these results we have nothing to do, but we do believe that the statement as quoted from Mitchell's book is correct, regardless of what its consequences may be. It is senseless to shut our eyes to a plain fact simply because we deplore it or the consequences that may follow it.

The Overhanging Arms of Millers.

Our British contemporary, *The Engineer*, is evidently considerably dissatisfied with the recent meeting of what it calls "the Society of Engineers" as a whole, but its special displeasure is aroused by Professor Sweet's paper, which we are told contains nothing not already familiar to all good tool builders. It says that "Mr." Sweet's idea about box sections is familiar but usually impossible to include in designs, and closes its article as follows:

"We have shown that there are two reasons against its [the box section's] general use. First, that it is not necessary, nor the best design for all conditions; secondly, that there are more things than strength to be considered. To reinforce the second argument we may mention a special case that illustrates our meaning admirably, and shows, at the same time, that the machine-tool maker is not such a bad designer as Mr. Sweet would have us believe. In the earlier days of milling the necessity for having great rigidity in the overhanging arm of universal type

machines was fully recognized. The arm was consequently a casting of rectangular section, and without any openings in its length. It was and is the best possible design for the arm; it gave both stiffness and resistance to torsion. Yet there are comparatively few milling machines made nowadays to this design. Why? Not because the makers fail to recognize that it is an excellent design from the point of view of strength, but simply because it does not permit of such a varied use of the machine as the more generally used round sliding bar."

Now this happens to be about the poorest possible illustration of the argument for the rectangular section is not the best possible design for the overhanging arm of a universal milling machine, and never was. It might be if the stresses resulting from the cuts were always in one direction and the arm were so designed as to be strongest in that direction. But he who takes pains to familiarize himself a little with the universal miller finds that the stresses produced by the various cuts come in all possible directions from vertically upward to vertically downward and everywhere between. Therefore the arm needs to be equally stiff in all directions, and the circular section is called for purely as a matter of design to resist stress and aside from all other considerations, though it happens of course that it is better also for other reasons.

The Speed of Grindstones.

Again are we reminded of the fact that certain questions pertaining to machine-shop practice are bound to come up once in so often. Just at present the subject of grindstones seems to be a live one, and from the letters we have published bearing upon this topic it will be seen that each user of grindstones has his own idea as to the velocity at which such stones may be run with safety. There seems to be no exact information along this line and each man installing a grindstone is forced to use his own judgment and experience in determining the maximum speed at which it should be driven, the result, in the majority of cases, being undoubtedly that, in an attempt to keep well within the safe limits, the stone is speeded too low and its efficiency thereby greatly reduced. On the other hand, it appears that certain of our contributors are running, or have been running, grindstones at what the conservative mechanic would consider an excessive rate of speed. As an illustration of the wide range of opinion on the subject, compare the velocity adopted by an English contributor, 1,600 feet per minute, with the nearly 5,000 feet peripheral speed established by a previous correspondent in the case of a pair of stones used for tool grinding. Another American correspondent writing recently on grinding practice mentions a stone which runs every day in the week at 4,300 feet per minute; and in this issue we publish a letter from a contributor who, in criticising the low peripheral velocity advocated by Mr. Unwin (page 57), states that in the shop where he is employed 6-foot grindstones from Ohio quarries are regularly run at 3,300 feet per minute, and that though eighteen machines using such stones have to his knowledge been in operation for eleven years, only two stones have burst within that time. Thus it will be seen that stones are being operated at practically all rates of speed up to 5,000 feet, and in this respect the grindstone question seems to be in about the same condition as it was when discussed in our columns in 1890. As will be recalled, reference to this discussion was made in a footnote appended to Mr. Unwin's contribution, and Mr. Chas. A. Bauer's formulas for safe speeds for grindstones were again given, the maximum safe speed as given fourteen years ago by Mr. Bauer being, for Ohio stones, 2,500, and for Lake Huron stones, 3,500 feet per minute. It will be noticed that the writer in this issue states that the two stones which burst were defective. And right in this possibility of hidden defects lies the chief source of danger in speeding up a stone. The methods followed by the Norton Company and other makers of emery wheels in testing their product have been described in these columns, and all mechanics realize the safety with which such wheels, because of the thoroughness of the test, may be operated at the speed designated by the manufacturer. If people getting out grindstones would adopt some such thorough system for testing their stones and thus eliminating (by bursting) all defective ones, it would undoubtedly be found that the majority of stones could be run at considerably higher and more efficient speeds than they are driven at at present. Of course the old rule of running grindstones so that they will not throw water is absurd—just as much so as it would be for emery wheels.

Spiral Gears Again.

Those of our readers who have followed the articles on laying out spiral gears which we have published from time to time will be interested in the addition to the list by Mr. Thompson which appears in another column. Most of the previous articles have had nothing to say about such gears when mounted on shafts at other than right angles and none, we believe, have offered solutions for those cases. The peculiar merit of Mr. Thompson's method is that, with little additional complexity, it applies to such cases as well as those in which the shaft angle is a right angle. It is also interesting from the fact that it attacks the problem in an entirely new manner, and to those who are interested in the problem as a problem this will appeal with quite as much force as will the increased range of the method.

$1,500,000 for the Union Engineering Building.

Though it has been understood or intimated that Mr. Carnegie would give more than the million dollars originally promised for the erection of a union engineering building, there has been, we believe, no specific information as to just how much he would give. We learn now that Mr. Carnegie has definitely increased his gift to $1,500,000, provided the civil engineers go into the matter.

We have received from the Lackawanna Railroad some photographs and an account of the moving of a 1,000-ton swing bridge from one pier to another in the Passaic River at Newark, N. J., and the lowering of it 10½ feet. Some time ago the *Engineering News* published a full account of the work written by the chief engineer of the road, and he concluded his article by the statement that the work was accomplished under about the most unfavorable conditions of weather, tide, etc., that were possible, without accident or untoward incident, and that this showed the excellence of "sand jacks" such as were used in doing the work. We think it showed more clearly the thorough competence of the man who directed the work.

Some New Things.

DOUBLE SWIVEL VISE.

The vise shown in elevation in Fig. 1 and in section in Fig. 2 has a swiveling body formed, as represented, in two sections, the two semi-circular projections at the bottom turned to fit and swivel in the seat provided in the base being adapted to tilt slightly in respect to each other and

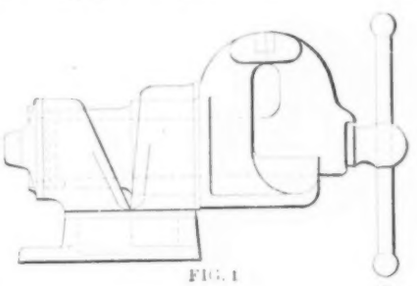


FIG. 1

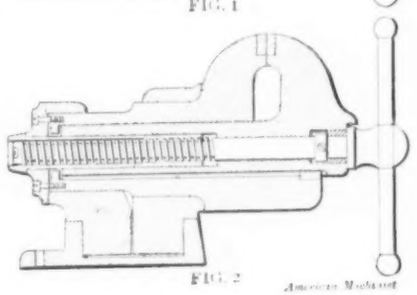


FIG. 2

DOUBLE SWIVEL VISE.

lock frictionally in the seat when the vise-jaws are tightened on a piece of work, this tilting action also allowing the jaws to be clamped—by the tightening of the screw—at any angle in the vertical plane. The method of mounting the jaws, and the arrangement of screw and nut are

clearly shown in the sectional view and need no explanation. The vise is made by the Automatic Vise & Tool Company, East Akron, Ohio.

14-FOOT PLAIN GRINDING MACHINE.

The engravings illustrate the latest development in the line of heavy plain grinders constructed by the Norton Grinding Company, of Worcester, Mass., the machine represented, which has a maximum swing of 18 inches and a swing over the steady rests of 8 inches, being designed to carry upon its centers work up to 14 feet in length and weighing up to 7,000 pounds.

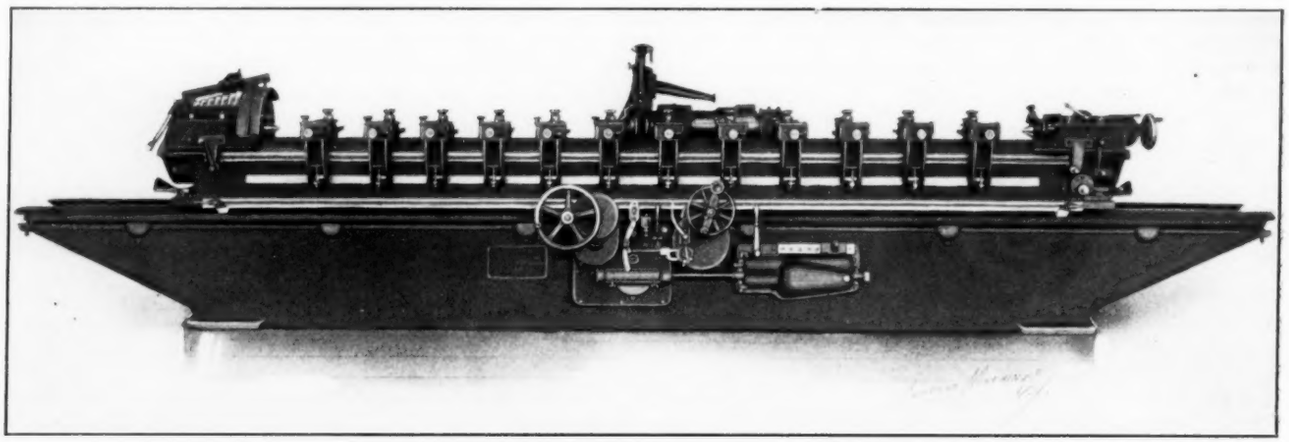


FIG. 1. 14-FOOT PLAIN GRINDING MACHINE.

The proportions of this grinder are well brought out in the front view, Fig. 1; this, however, does not show the wheel spindle slide and its support, but it may be explained that spindle, bearings and slide are practically duplicates of those used on the Norton 96-inch grinder illustrated by us at page 360, Vol. 24, the heavy slide resting, as in the case of that machine, upon one large V and one broad flat way. The bed carrying the work table and the wheel slide is a single massive casting 22 feet long and weighing 10,500 pounds; the swivel table, which is practically triangular in section, weighs with the sliding table below, 5,000 pounds; and the headstock and footstock, also very heavy, and having spindles whose taper holes measure 3 inches in diameter at the mouth, are adjusted by crank-operated pinions engaging with a rack at the front of the table. The table carries, as shown, a large number of steady rests for the work, these together with the massiveness of the moving parts preventing vibration in the piece under the action of the wheel. The latter, by the way, is 24 inches diameter, and guards are provided suitable for 1- and 2-inch face wheels; also for 4-inch face where required.

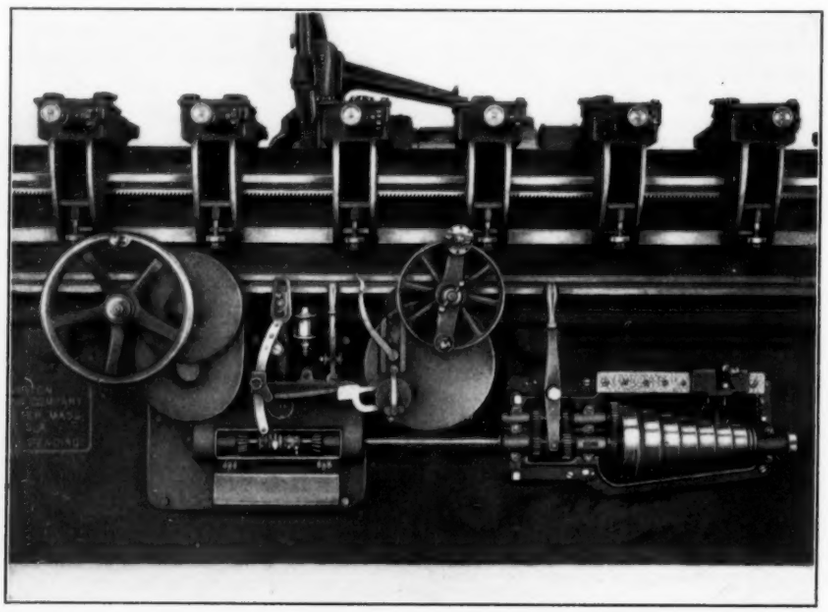


FIG. 2. TABLE DRIVE AND CROSS-FEED GEAR.

The speed of rotation of the work is varied at will by a movement of the slide shown at the top of the headstock, this slide guiding the belt up and down the cone. To facilitate the shifting of this belt, the handle at the left of the headstock is depressed, raising the cone which swings upon a common center with, and is geared to the whirl on, the spindle. When in place this swing frame is locked by a small lever located at the top of the head. The cone having eight steps, and there being one change in the speed of the overhead works, sixteen different speeds for the work may be obtained.

The mechanism at the front of the bed is shown on a larger scale, and with the covers removed, in Fig. 2. At the right is the speed frame containing the cone and gears for regulating the speed of traverse of the table. The belt is moved along from step to step by the handle and slide shown directly over the cone. The vertical lever may be operated to throw the clutch, shown between the gears, to the opposite gear and give a slower motion to the shaft that extends into the drive plate and reversing gear to the left, the seven-

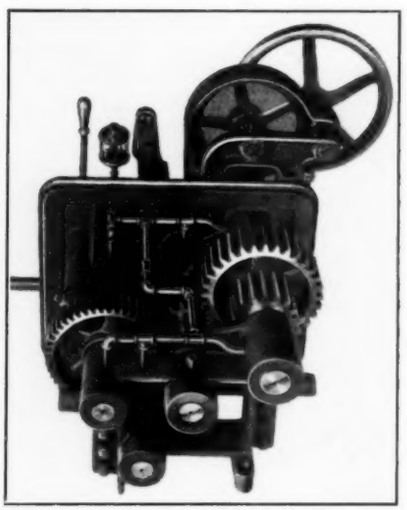


FIG. 3. TABLE OPERATING MECHANISM—REAR VIEW.

step cone and gearing thus giving fourteen changes of speed for the table.

Fig. 3 gives a rear view of the plate with the mechanism attached for moving the table by hand or automatically, this plate carrying at the front, as shown in Fig. 2, a large hand wheel, the table reversing lever and the device by which is varied the depth of cut of the wheel when using the automatic feed. In the group shown at the center of Fig. 2 will be seen a dial with eight holes. When the ball handle below is screwed up tight the lever on which this dial is fixed is made fast to its stud. The operator may then move the emery wheel forward or back by turning the small crank seen on the dial, the movement of this crank from one hole to the next reducing the diameter of the work 0.00025 inch, and one-half turn of the crank giving 0.001 inch reduction in diameter. When the ball handle is released the wheel is moved forward or back by means of the handle at the bottom of the wheel. This wheel is provided with regular gear teeth and the pawl at the top, when thrown in contact, operates in these as though they were ratchet teeth. Upon the axis of the small crank on the dial is a case-hardened pinion with eight teeth meshing into the gear wheel and actuated by the small crank, as described. This feed gear has upon its hub a pinion which engages with a larger gear located inside the casing shown at the center, this gear being fastened on the end of the cross-feed screw which passes underneath the work table and the cross-slide carrying the emery wheel. The cross-feed screw is shown in Fig. 4, which gives also a rear view of the pawl actuated wheel with the small dial, crank, etc. There is a slight difference in the detail of the two engravings, the last one showing a small hand-wheel, while in Fig. 2 the operating handle is carried by the lever instead. The cross-feed screw has, as represented, a bearing in the front bracket, while the other bearing is upon the tops of the threads over the entire length of the screw, these threads being of the Acme form. The screw is made of very high carbon crucible steel, and the threaded portion is 3½ inches diameter and about 18 inches long. The tops of the threads are ground, and rest as shown in a half-round bearing formed in a very heavy casting bored and finally scraped to fit the screw. The combined thread tops are equal in area to a bearing 3½ inches diameter by 4 inches long, and this being distributed over the entire length of 18 inches gives a rigid support to the screw. The half-round bearing is secured to the under side of the cross-slide base and forms, besides a support, an efficient oil pocket for thoroughly lubricating the screw. The nut which is fast to the wheel slide is a half nut about 10 inches in length which is scraped in its threads to accurately bear upon the screw. The thrust of the latter is against the beveled end and a bronze plug which is imbedded in a massive casting, the small grooves shown in the beveled surface carrying oil to the bearing surfaces. The bearing for the screw and the method of embedding the thrust plug preventing all spring, make it possible to move the heavy wheel slide ahead accurately one-eighth of a thousandth, if desired, either by hand or automatically, as the screw if moved at all must rotate—in fact, it is perfectly practicable with this mechanism to remove any amount of material from steel work by quarter thousandths or by thousandths up to five or ten thousandths diameter, according to the area of the surface of the work, and obtain accurate sizes, automatically, or by turning the small crank by hand.

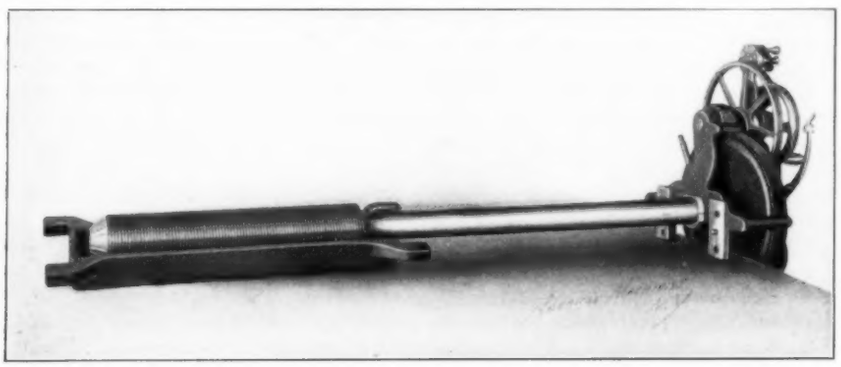
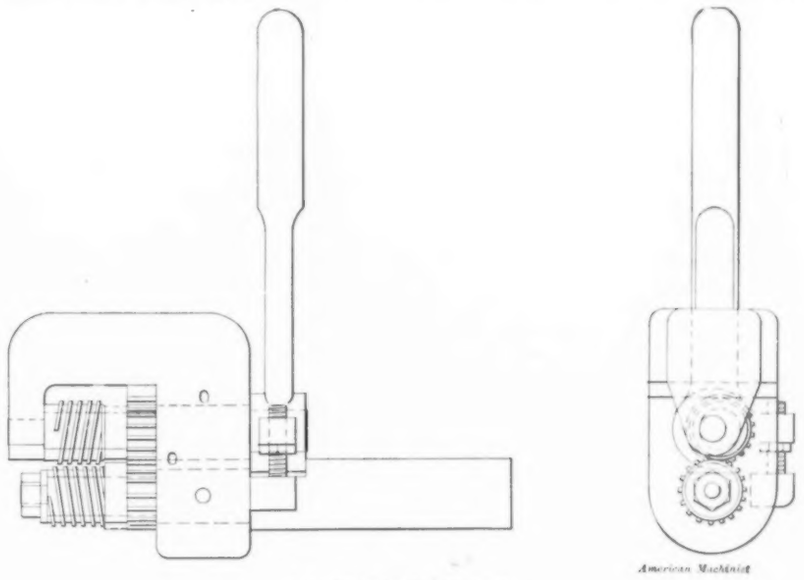


FIG. 4. CROSS-FEED SCREW.

The machine is supplied with overhead works and pulleys capable of transmitting 15 horse-power, and 1 cubic inch of steel per minute may be removed from nearly all diameters. The compound for wet grinding is supplied at the rate of 35 gallons per minute. The total weight of this grinder is about 22,000 pounds.

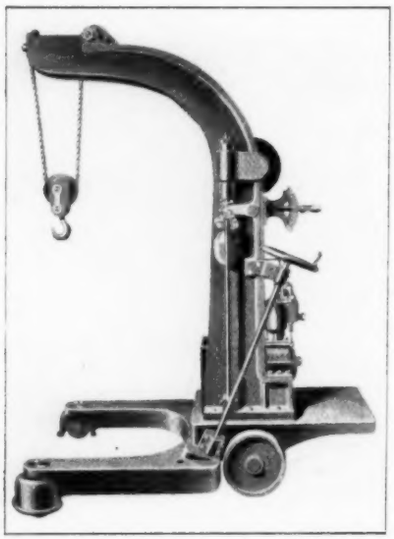
A TUBE-THREADING TOOL.

The cut shows a device recently patented by Chas. R. Gabriel, Providence, R. I., for threading the ends of thin tubing, the threading being done entirely by rolling the metal between an interior and exterior former. The tool is mounted by the shank in the footstock spindle while the tube to be threaded is rotated by the lathe. The lower former, which goes inside the tube, is a hollow sleeve which rotates freely upon a fixed stud, the upper or exterior former rotates upon the eccentric portion of a spindle operated by the vertical lever. The gears on the formers are of the same size and are always in mesh, the threads being so located with reference to each other that each thread of one is always opposite a thread-space of the other, and *vice versa*. When a tube is to be threaded the lever is moved to raise the upper former so that it will clear the tube and the tool is advanced until the lower former projects into the tube as far as it is desired to form the thread. The exterior diameter of the lower former corresponds with the interior diameter of the tube, so that when pressure is put upon the outside of the tube it pinches the former within it, and they rotate together. A movement of the lever brings the upper former down and the desired thread is produced by the



A TUBE-THREADING TOOL.

pressure upon the tube between the formers. An adjustable stop is provided for the lever so that each thread rolled will be of the same size. When the upper former is raised the tube unscrews from the lower former, sending the footstock backwards

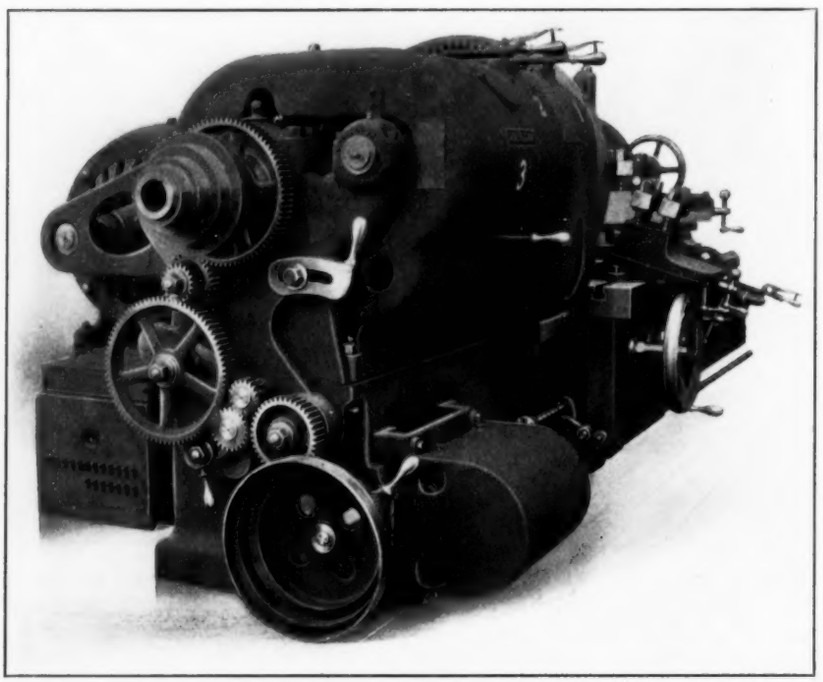


PORTABLE POWER CRANE.

sufficiently to clear and the job is completed.

PORTABLE POWER CRANE.

The portable traction crane here shown is manufactured by the Franklin Portable Crane & Hoist Company, Franklin, Pa., and is substantially their portable hand crane equipped with power to operate both the traction and hoisting mechanism.



36-INCH MOTOR-DRIVEN LATHE WITH NEW HEAD.

Both electric and gasoline motors are employed, the accompanying engraving showing the crane equipped with a gasoline motor. The electric crane is of very much the same appearance except that the operator's platform is made somewhat longer for the purpose of receiving a storage battery which is located in a crate beneath the platform.

Both the hoisting and traction mechanisms are actuated by one motor and by the use of a single lever either the hoist or the traction gear may be brought into operation, or both may be disengaged from the action of the motor, but to avoid accidents it is made impossible to throw into action both the hoisting and the traction gearing at the same time.

In the cranes which are equipped with a gasoline motor, the steering wheels are in the front end—one in the extremity of each arm of the U-shaped bed and the traction wheels are immediately beneath the operator's platform.

The traction mechanism is provided with a compensating gear of the spur type to eliminate all strain while traversing curves. The circulating tank which carries the water for cooling purposes, also the fuel tank, are mounted between the jib standards, thus occupying a convenient and protected position. Electric ignition is employed. The clutch by which the main gearing is connected with the motor is a friction clutch, so that all shock or wrenching of the gearing is avoided when the same is thrown into action.

36-INCH MOTOR-DRIVEN LATHE WITH NEW HEAD.

This tool is a heavy, triple-geared machine built by the American Tool Works Company, of Cincinnati, Ohio, for the League Island Navy Yard, the all-gear head, though here motor driven, being of the same construction (aside from the triple gearing) as the head of the belt-driven lathe built by the same concern and illustrated in Vol. 26, at page 1677. Through this geared arrangement four fundamental speeds arranged in geometrical progression are obtained, and by the triple gearing the geared speeds are increased in number to eight. The gaps between these speeds are filled in by the motor variations; the increments through this drive vary by small amounts, 10 per cent. variation being readily obtained. The motor—a 9 horse-power machine—has a total speed variation of 100 per cent., and, owing to the numerous speeds derived through the geared mechanism, can be smaller than would be possible were the head an ordinary back-geared one depending upon the motor for the greater proportion of its speed changes. The motor is connected to the driving shaft in the head by a pitch chain; the controlling mechanism for starting, stopping or reversing is located conveniently at the right-hand end of the carriage.

Technical Publications.

"Hendrick's Commercial Register of the United States." Thirteenth Annual Edition. 1,226 7½x10-inch pages. Samuel E. Hendricks Company, New York. Price, $6.00.

This well-known publication is a trade index devoted especially to the interests of the architectural, mechanical, engineering, contracting, electrical, railroad, iron, steel, mining, mill, quarrying and kindred industries. The industries are arranged alphabetically, the section for each industry being divided alphabetically by States, then subdivided alphabetically by cities and again arranged alphabetically by firms. An index of forty-two four-column pages refers directly to the various industries, liberal use being made of cross-index entries.

"The Factory Manager and Accountant." By Horace L. Arnold. 431 6x9-inch pages with numerous illustrations. *The Engineering Magazine*, New York. Price $5.

This book, by one who will be recognized as a frequent contributor to our columns, is at once an illustration of the great increase in the attention now being given to the subject of systematic factory management and cost accounting and a source of information for those interested. As our readers are well aware, Mr. Arnold has very little use for theory, and his book contains none of it. After a chapter on the importance of the subject and another devoted to recent advances in the art, he takes up in succession and in full detail the methods followed by a number of representative concerns in very different lines of industry. These include the Link Belt Engineering Company, the Bigelow Company, the C. B. Cottrell & Sons Company, the Potter & Johnston Company, the Wells Brothers Company and the C. W. Hunt Company. The vari-

ous blank forms are shown, and their uses and relationships to one another are clearly set forth. The author's previous work, "The Complete Cost Keeper," was well received, and the present book, which is, of course, of much wider scope, covering as it does the complete administration and management of factories, will, we have no doubt, receive corresponding recognition.

"Miscellaneous Scientific Papers of the Allegheny Observatory—New Series No. 16" consists of a monograph by Prof. F. L. O. Wadsworth "On the Construction of Telescopes whose Relative or Absolute Focal Length shall be Invariable at all Temperatures." This is an elaborate and scientific treatment of the problem of using material for the tube of a telescope having such coefficient of expansion by variation of temperature as will just compensate for the variations of the focal length which take place under varying temperatures of the objective glass, which also may be chosen with reference to its adaptability in this respect to a given tube.

"The Metric Fallacy," by Frederick A. Halsey, and the "Metric Failure in the Textile Industry," by Samuel S. Dale. New York: D. Van Nostrand Company. Cloth. 231 6x9-inch (153x230 mm.) pages. $1.00.

We quote as follows from the preface: "This book is an outgrowth of a paper presented to the American Society of Mechanical Engineers at its December, 1902, meeting and the discussion which followed, and by permission of the Council of that society much of the paper is here included. The points raised in the discussion have been rewritten and placed in their appropriate places. The list of countries in which it was shown in the paper that old units continue in use has been about quadrupled, while new chapters have been added on The Reasons for the Failure of Compulsory Laws, Scientific and Industrial Measurements, Scientific and Industrial Difficulties, "The Government Will Pay the Cost," the "Confusion" of our Weights and Measures, The Complications Due to a Mixture of Units, The Inaccuracy of the Meter, The Abandoned Portions of the Metric System and The Object of the Bill." Part 2 of the book, as the title indicates, relates to the use of the metric system in the textile industries.

Personal.

George A. Bates, who formerly lived and worked in Hartford, has returned there, after an absence of thirteen years, and is superintendent of the shop of L. E. Rhodes.

W. S. Chase, sales manager for the National Acme Manufacturing Company, Cleveland, Ohio, sailed for Europe on January 16, contemplating a business trip to cover about two months.

E. Stutz informs us that the date of his lecture on Thermit before the American Chemical Society of Boston has been changed to February 25, in order to make Huntington Hall available for the purpose.

T. H. Bailey Whipple has returned to the Sawyer-Man Electric Company to the position which he left last summer in order to take a part in the reorganization of the sales department of the Nernst Lamp Company, of Pittsburgh.

Obituary.

Christopher Hotz, of the firm of Schuttler & Hotz, wagon builders, Chicago, died January 13, sixty-two years old. Mr. Hotz was born in Germany and graduated from an engineering college at Karlsruhe. He was for some years with Sulzer Brothers, Winterthur, Switzerland, where it is said he invented the valve motion of the Sulzer engine and other devices. He came to this country in 1866, and in 1869 the great wagon business of Schuttler & Hotz was started. This concern now employs 600 men and can turn out 20,000 wagons a year.

Frank W. Holly, superintendent of the Holly Manufacturing Company, Lockport, N. Y., died January 16, fifty-three years old. He was a son of the late Birdsill Holly, inventor of the Holly system of water works. He was born at Seneca Falls, N. Y., and was trained as a mechanical engineer in his father's works, and for several years was erecting engineer of the company. In 1878 he became general manager of the Detroit Steam Heating Company, but in 1880 he returned to Lockport. He was a member of the American Society of Mechanical Engineers and of the American Water Works Association.

Commercial Review.

NEW YORK, Monday, Jan. 25, 1904.

The probabilities are that before many weeks shall have elapsed, machine-tool men will be able to announce that they have closed some good orders. At this writing we know of several machine-tool propositions that are in better condition for closing than at any time since knowledge of them first reached the trade. Two of these relate to railroads, while four others represent manufacturing interests. One of the latter, to which many eyes in the trade are directed, is for the equipment of the new plant of the A & M. Crane Company, at Bridgeport, Conn. Estimates differ as to the probable outlay for the machine tools that are to be installed in this plant, some putting it at as low as $50,000, while others say it might run up to as high as $100,000.

Machine-tool men in general all say that the business situation so far as it concerns them, has been better since January opened, than it was in December. Every week that has passed during the present month, has brought about a larger number of inquiries than the one which preceded it. This is one of the most encouraging signs that the new year has developed, and shows that people are willing to talk business, even if they don't close any. Some want the newest tools in the market, while others are willing to take a second-hand tool of good make if they can get it reasonably. One well-known Liberty street house, for example, bought the machine-tool equipment of a certain concern that went out of business on the first of the year. The tools were all of well-known make, and the concern in question informs us that it never disposed of any tools so easily and so quickly, as it did those to which we have reference. The prices obtained, our informant says, were very satisfactory.

There is every reason to believe that the waiting policy pursued by railroads, in connection with the machine tools they intend to purchase, will soon be broken, at least in part. Since the new year opened some railroads have made some pretty fair purchases of machine tools, but these do not bear even a remote relation to those they are known to have decided on purchasing. In the past, they have not placed the necessary orders, because of the uncertain conditions in the financial world, especially as regards money. But during the past few weeks the financial skies have cleared considerably. Money has become "a drug," to use a phrase which Wall Street employs to denote a plentiful supply of the "long green." Call money has been loaning at 1½ and 2 per cent., time money for six months at 4 per cent., and money for industrial purposes at 4¼ to 4¾ per cent. That no stringency is expected is shown by the willingness of banks to loan money for the entire year at 4½ per cent. So it will be seen that if the railroads have given the real reasons for their failure to purchase machinery they need, the fact that these no longer obtain, or if they do but slightly, ought to make the prospects of their entry into the machinery market better than they have been in months.

American manufacturers of machine tools always take an interest in what their competitors in other lands say of them. For this reason, the following excerpts from a letter written by the head of the sales department of a leading Canadian machine-tool house to a friend in this city recently, are presented:

"An article appeared in the AMERICAN MACHINIST recently which stated that machine-tool concerns in Canada were apprehensive of an American invasion with lower prices, but that American manufacturers interviewed said they had no intention of doing anything of the kind. This is not a true state of affairs. We have a confidential letter from a friend who obtained quotations from several of the leading concerns in New York, quoting him prices for the home market, but to the Canadian trade quotations were based on

export prices which are from 10 to 12 per cent. better than they will sell for in the home market, and to the Canadian trade they give an extra 2½ per cent. over and above the regular export price. When asked why they named this additional 2½ per cent., he was informed that they could send machine tools into Canada on skids the same as they would ship in the United States, and for the European trade they had to be boxed, which they figured was equal to 2½ per cent., and for that reason they would give an extra 2½ per cent. to the Canadian purchaser. Another thing is that American machinery firms are advertising their wares more extensively in Canada than they have in some time. In addition, they are shipping surplus machinery for stocking purposes to Canadian brokers. In any of the machinery warerooms, either in Toronto or Montreal, you will find large stocks of American machine tools such as made by the Cincinnati makers and some of the other Eastern firms, and we understand from good authority that they are even shipping this machinery into Canada, consigning it to Canadian brokers to be sold whenever possible. This, together with travelers direct from the houses, is pretty good evidence that the machine-tool makers of the United States are giving as close attention to the Canadian market as they would almost to a neighboring State. There is no doubt that it is going to have its effect on the Canadian machine-tool builder and that effect is going to be felt very quickly."

One of the most representative men in the machine-tool trade in Cincinnati, asked as to the foregoing statements, replied:

"To say that Cincinnati machine-tool men are sending their products to Canada to be sold whenever possible, is not so; neither is there anything in the statement that lower prices are being quoted to Canadian buyers. The 25 per cent. tariff is enough of a handicap, without going into anything like that. That American manufacturers have become a little more active recently in trying to make their products known in Canada, is true, but for the writer of that letter to quote that by way of corroboration for his statements, is giving the matter undue importance. Beside, there is not enough business in Canada for American machine-tool men to adopt the extreme methods of doing business as that Canadian writer outlines. In Cincinnati prices are being strictly maintained."

A local machine-tool merchant was asked for his opinion of the letter:

"I can say for a positive fact that there are no concessions being made to Canadian buyers. During the past week, for example, we had inquiries for three machine tools from Canada, whose aggregate value was about $6,000. We made a special effort to get a reduction from the manufacturers, but were unsuccessful. Price lists for American machine tools are being rigidly adhered to."

Another machine-tool dealer, after expressing himself in a similar manner to those we have quoted, added:

"I am afraid our Canadian friend is not doing the business he would wish, and, wanting to find some excuse for it, lays it at the door of American manufacturers. You know it's an awfully consoling thing, when anything goes wrong, to blame it on somebody. I have been there myself, and know how it is."

The fire which occurred at the works of E. W. Bliss Company, at Brooklyn, N. Y., last week, and which was confined to two upper floors, did not inconvenience the company long, for the men returned to work to-day. We are informed that no damage was done to the machinery outside of water, and that the ill-effects of this will only be temporary. The amount of the damage to the plant has not been computed, but surface indications, it is said, would make $125,000 a conservative estimate, which is covered by insurance.

The Jeffrey Manufacturing Company, of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, of the same place, is now soliciting orders for high-grade malleable castings.

The export house of Davis, Allen & Co. has been reorganized, and will be known hereafter as Allen, Halle & Co., with offices at 70 Wall street, this city.

CHICAGO MACHINERY MARKET.

Not in many months has there been in any branch of the Western machinery market a change in the outlook so radical as that which has occurred during the past four weeks. It is strongly marked in the electrical machinery trade. With perhaps not a single exception, the representatives of electrical machinery manufacturers located here say they have far better prospects for doing business than at any time within six months or longer.

There was put off until the new year a large amount of business and much of this is now under negotiation. Again, the business outlook has so greatly improved that buyers are more disposed to proceed with contemplated improvements. The protracted slump in steel corporation stocks, reputed omen of dire disaster to the metal trades, which hung relentlessly over the market during the closing months of 1903, has disappeared. It is commonly said here that that decline in security values did not directly affect much business adversely, but that the hesitation produced retarded trade immensely. Now that the scare has departed, inquiries have revived and exuberant factors are saying they look for a trade during the first half of 1904 fully as good as that for the corresponding period last year.

The actual amount of business closed during the first three weeks of the year was not perhaps particularly inspiriting, though the aggregate trade was sufficient to save the market from dullness. But the character and volume of the inquiry has so changed that much is expected of it. Thus the representative of the C & C Electric Company remarks that there is now more inquiry than at any time in six months. He did not know what percentage of the business his company would get, but he did not believe that 10 per cent. of it would fizzle out.

The Milwaukee Electric Company say they have had a better trade during the past three weeks than for any similar period in the history of the company. Among other orders secured was a large installation for the Schlitz Brewing Company.

The Northern Electrical Manufacturing Company say they are now figuring on a greater number of propositions than at any time in a year. It is not being closed up rapidly, but all appearances are for an active trade during the next few months.

The Commercial Electric Company has sold a 100-kilowatt generator for street railway service at Kenosha, Wis.

One favorable sign is that the steam railroad companies are beginning to buy motors again for their shops, after being out of the market almost entirely for several months. And the trade of some of the electrical machinery makers this month has run largely to small motor business, none of especial size, but aggregating a satisfactory month's volume.

Quotations.

NEW YORK, Monday, Jan. 25, 1904.

New York prices for Northern and Southern irons for nearby delivery are, nominally, as follows:

Northern:	
No. 1 X	$15 25 @ $15 75
No. 2 X	14 75 @ 15 25
No. 2 plain	14 25 @ 14 75
Southern:	
No. 1 Foundry	14 00 @ 14 50
No. 2 Foundry	13 25 @ 13 75
No. 3 Foundry	12 75 @ 13 25
No. 4 Foundry	12 25 @ 12 75

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.40c. upward in carload lots. Soft steel bars, 1.45c. upward.

Tool Steel—Base sizes—Good standard quality, 6¾ @ 7c.; extra grades, 13c. and upward.

Machinery Steel—Base sizes—From store, 1.80c.

Cold Rolled Steel Shafting—2.65c. from store for base sizes.

Copper—Lake Superior ingot, 12⅝ @ 12⅞c.; electrolytic, 12½ @ 12¾c.; casting, 12⅜ @ 12⅝c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 27.75 @ 28.10c.

Pig Lead—4.60 @ 4.65c.

Spelter—4.95 @ 5.05c.

Antimony—Cookson's, 6¾ @ 7c.; Hallett's, 6⅛ @ 6¼c.; other brands, 5⅝ @ 5¾c.

Lard Oil—Prime City, 61 @ 63c., according to brand and quantity, ranging from one barrel up to large lots.

Standard Size, 9 x 12. FEBRUARY 4, 1904. Price Ten Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 27. WORLD BUILDING, NEW YORK. No. 5.

Index to Advertisers and Classified Index Following Reading Matter.

Card Is A Specialist In The Making Of Taps.

Card makes nothing but taps and things kindred thereunto. Card's experience runs back something like a quarter of a century, and think you that in this time Card hasn't had an experience worth while? Card's twenty-five years of effort have been the means to present Card excellence. The snares and pitfalls coming to those who attempt tap making now have been passed by Card years ago. Card's later efforts have been along the lines of economical production to the end that Card Taps and things, with all of their quality and usefulness, be sold at about the same price as those "next best;" Card's idea being to take away the last possible excuse for not using them. So the matter stands at this time: Card's Taps are a little better than the "next best," much better than some others, and they are sold at about the same price as any.

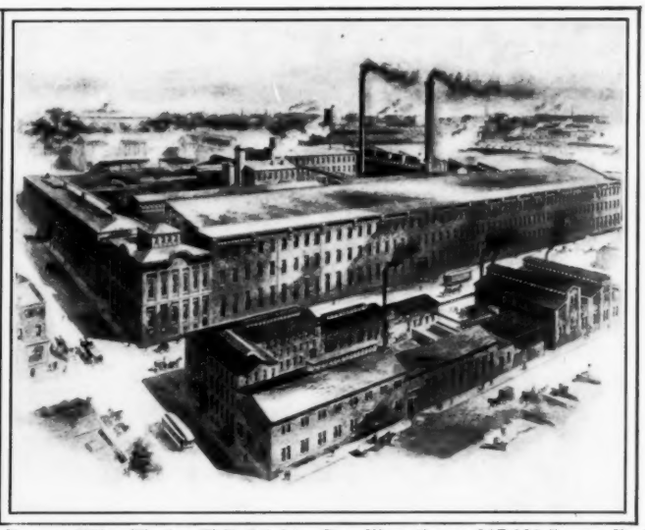
Card's New Catalog is on the press and will be ready for delivery shortly. In order to insure the prompt receipt of a copy, you would do well to send your request now. This will be a catalog worth having.

S. W. Card Manf'g Co.

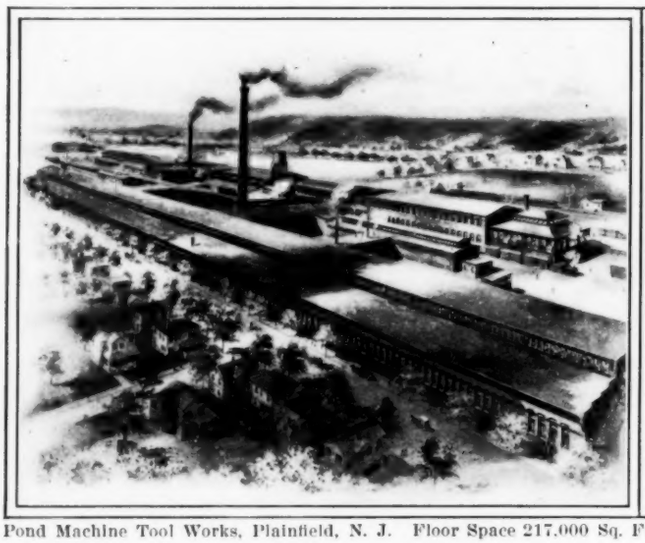
Mansfield, Mass., U.S.A.

Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Glasgow.

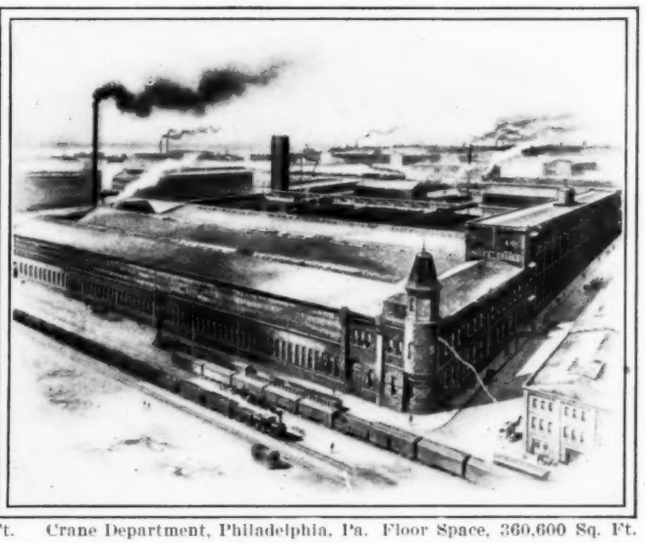
Niles Tool Works, Hamilton, Ohio. Floor Space, 356,000 Square Feet.



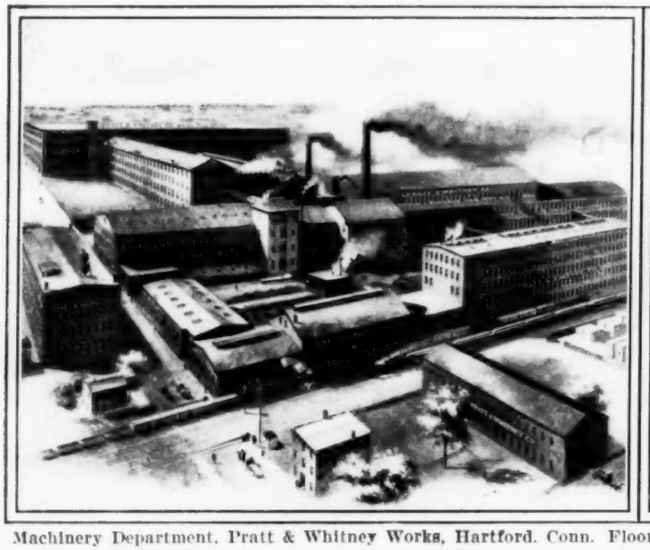
Bement-Miles Works, Philadelphia, Pa. Floor Space, 217,800 Square Feet.



Pond Machine Tool Works, Plainfield, N. J. Floor Space 217,000 Sq. Ft.



Crane Department, Philadelphia, Pa. Floor Space, 360,600 Sq. Ft.



Machinery Department, Pratt & Whitney Works, Hartford, Conn. Floor Space, 374,280 Square Feet.

Small Tool Department.

Views of Works. **NILES-BEMENT-POND CO.,** **136-138 Liberty St., New York.**

See Last Four Pages Preceding Back Cover.

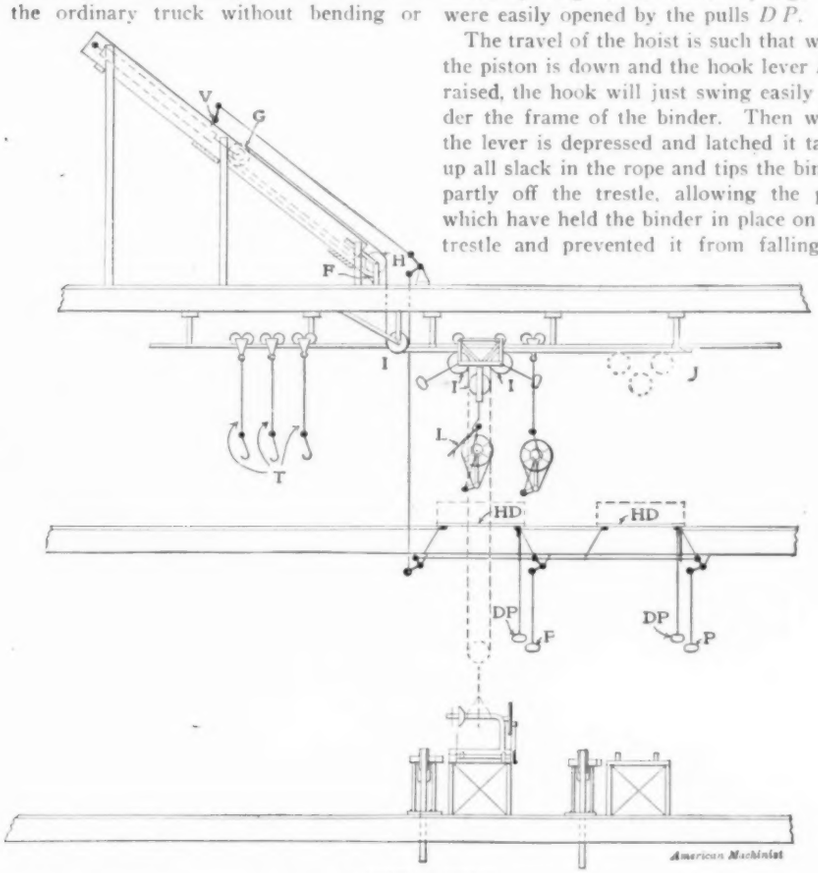
OFFICES:

Boston: 144 Pearl St. Chicago: Western Union Bldg. Pittsburgh: Frick Bldg.
St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. AGENTS: The Fairbanks Co., 749 Craig St., Montreal, P. Q.

A Special Lift.

BY S. A. WORCESTER.

The binder attachment for a harvesting machine, after being assembled, is "run off" or tested by running it for a short time and making it bind a certain number of bundles of straw. The Ohio firm for which I designed the special lift here shown had been taking the binders, after "running off," one at a time, on a special truck designed for the purpose, hauling them about 50 feet to an elevator, hoisting them from second to third floor, then hauling them about 100 feet farther to the stands on which they were placed for painting with a brush. The binder, which weighs 185 pounds, has light projections on all sides and cannot be laid down on the ordinary truck without bending or breaking some of these parts; hence the special truck. The elevator mentioned was used only for hoisting binders, and occupied valuable room on three floors, besides being too far from the work. It was decided to abandon brush painting and to paint and varnish by immersion in tanks of ample size and to move and store the binders while drying by a complete overhead trolley system with several hundred trolleys and a large number of switches. It was also decided to take out the elevator and to install a special lift directly over the run-off trestles.



A SPECIAL HOIST.

As the attic was not high enough to admit the air lift in a vertical position, it was set in an inclined oak frame, with guides for the crosshead with its two sheaves. The wire rope, of ¼ inch diameter, is fastened at *F* and passes first halfway around one 14-inch sheave at *G*, then half around one sheave at *H*, then half around a second sheave at *G*, then partly around a second sheave at *H*, then over the four sheaves *I I I I*, its end being fastened at *J*. The 6-inch air piston has a stroke of 7 feet, which gives the rope and the hoisting hook movements of 28 and 14 feet respectively. The air valve *V* is connected by rods and bell cranks, as shown to the two pulls *P P*. The two beveled hatchways were lined with sheet steel and were covered each with two doors *H D*, of ⅛-inch plate, stiffened by light angles riveted on. These doors were nearly balanced by long coiled tension springs and were easily opened by the pulls *D P*.

The travel of the hoist is such that when the piston is down and the hook lever *L* is raised, the hook will just swing easily under the frame of the binder. Then when the lever is depressed and latched it takes up all slack in the rope and tips the binder partly off the trestle, allowing the pins which have held the binder in place on the trestle and prevented it from falling to the floor to be removed. At the upper end of its travel the sheave yoke of the hoisting sheave stops against a plate on the under side of the trolley frame and brings the binder to just the proper hight so that the hook of the trolley on the other rail, 5 inches from the hoist trolley rail, will just swing under the binder frame nicely. Then by unlatching the lever L the binder can be lowered easily from the hoist hook into the trolley hook. Now, says somebody, why not do away with this hook lever and just use the air itself for raising and lowering the short distance necessary for hooking and unhooking? I answer that time, which is counted in seconds in this work, would be wasted, waiting for the air to exhaust for lowering and to accumulate pressure for hoisting. And an extended experience with the air lift shows that it is not a success for lifting a load instantly from rest and instantly stopping at a fixed short distance, or for lowering in a similar manner. In this case, to work quickly it is necessary first to lift the binder just far enough to allow the pins holding it to be withdrawn, and if it is lifted an inch too far it binds the pins. Again, at the top, if the air were exhausted to lower the binder, several seconds would elapse in exhausting, and then the binder would drop suddenly and be likely to miss the trolley hook. Several air lifts were in use on the third floor at the time this one was installed, and they all required about three to four times as much time in hooking and unhooking as this lever arrangement. Guards, not shown, are placed around all the sheaves to prevent the rope from fouling.

The cycle of operations with this lift is about as follows: When the test or "run off" is finished, and while the assistant, a boy, is disconnecting the binder, the operator pulls the air-valve handle *P* and also opens the doors with the handle *D P*. By the time the boy is ready, say eight or ten seconds, the hook, with its latched lever raised, is at hand and he hooks under the binder and depresses the lever, raising the binder a little. The operator then withdraws the pins and pushes up the handle *P*, and, after the binder has passed through the hatchway at a speed of, perhaps, 100 feet per minute, he allows the doors to close. The painter's boy now brings up one of the trolleys *T* and swings its hook with two prongs not so widely spread as those of the hoist hook. He swings this hook under the binder on the opposite side from the hoist hook and, unlatching the lever *L*, lowers the binder into the smaller hook, and gives it a shove toward the dipping tank. He then pulls the hoist trolley over to the position shown by the dotted circles, to be ready to hoist from the other run-off trestle.

The Court of Patent Appeals.

Senator Platt, of Connecticut, has presented to the Senate the report of the Committee of Patent, Trade-Mark and Copyright Law, of the American Bar Association, on the subject of a Court of Patent Appeals, and this expresses very clearly the needs for such a measure, in the light of the experience of those most interested in the matter, and in the best position to know what is required.

This subject has been receiving the attention of the Patent section for several years, and the bill before Congress is the result of prolonged study and consultation by the members of that section of the Bar Association.

Attention is called to the fact that the present system is a breach of faith on the part of the government to both patentees and the public. The Constitution and the statute recognize a right of property in

invention. They authorize the granting of patents vesting title to the property. The title rests on the grant. It rests legally only by force of the statute. It is of value only as it is supported by the law and the courts. Without courts sufficient in number, jurisdiction and organization to uphold the patentee's rights wherever they may be invaded the grant is in effect a fraud on the guarantee. It is a short-lived grant. Relief against those who disregard it must be prompt or it will be inadequate. It is a case in which justice delayed is justice denied.

The people are commanded by the law to respect the rights of patentees. They are charged with knowledge of the law and of the existence and contents of patents. They are bound to know whether a patent is valid or not. An invalid patent is a wrongful grant to an individual of that which justly belongs to the public. The decisions of the courts of last resort show that more than half of all patents granted are invalid. Society is entitled to the benefit of the mere scientific knowledge and mechanical skill of all its members without the payment of tribute in royalties.

Our judicial system fails to meet these plain requirements of justice. We have, in effect, nine Supreme Courts for the trial of patent cases. They are not bound to follow one another's decisions in respect to the same patent on the same facts. A patentee having established the validity of his patent in one Circuit Court has no certain assurance that it will be respected in another. A manufacturer who has defeated a patent in a suit against his customer in one circuit may be compelled to defend another customer in another Circuit Court against suit on the same patent and fight the whole ground over again. A patent upheld by one Circuit Court of Appeals may be nullified by another

The power of the Supreme Court to hear patent appeals on certiorari affords no substantial relief. A patent is too short-lived to survive the proceedings. The government issues to the inventor a grant which purports to invest in him a legal title to his invention for the whole country. But it fails to provide means by which he can establish that title against trespassers for the whole country. It issues as many illegal patents as legal ones, and yet fails to put it within the power of the people to protect themselves against wrong by the holders of them.

When we consider the part which patented invention has borne in the development and prosperity of the country, the capital and labor invested in that form of property, and the extent to which patented inventions enter into all industries, this omission of the government to provide adequate means for settling controversies about patents is nothing less than a flagrant failure in the discharge of plain duty.

There should be one court of appeals in patent matters because each patent covers the whole United States, and a suit on it is in reality one between the patentee and all the people in the United States, the issue being the right of the patentee to exclude the public for a time from the use, without his consent, of the thing patented or alleged to be patented. When brought into litigation, the patent should be dealt with once for all by an appellate court, whose conclusions would be binding upon the courts and the people of the whole United States. It is only in this way that the patentee and the public generally can become assured of the extent and limitations of their respective rights. Moreover, all patents should be dealt with not only in accordance with the same rules of law, but with the same spirit and from the same point of view, and this is possible only when as to all patent questions there is a single court of last resort. A. F. T.

Removing Shrink Fits—Freeing a Set Idler.

BY D. S. COLE.

Having had considerable experience with thermostatic devices and in connection with them having studied the expansion of substances due to changes of temperature, I was considerably interested in the remarks of "Oil Stone," at page 1797, Vol. 26, concerning what he calls a "reverse expansion trick." I note that he says that several schemes were tried, with more or less success, until the reverse expansion trick was accepted as the best practice, from which it may be possible that he has tried methods somewhat like the one which it occurs to me I should try if I were confronted with such a problem.

I consider the method he describes as very questionable practice, from the fact that the enormous strains produced by such severe treatment would be very liable to start cracks in the head, if not to fracture it completely. Strain cracks so produced might not be noticeable upon ordinary inspection, and yet they might be there or develop and cause the head to break in the cylinder under the heavy jars of service, and thus probably wreck the cylinder, if not do greater damage. From the fact that "the rods were breaking with great frequency" and that "it was necessary to fit each rod to the head it was to go into when it was to be used, as making them on stock order would not make a fit that would hold," it is evident that the heads were subjected to such enormous strains as to permanently and positively distort them each time a broken rod was removed, to say nothing of the additional strains produced in them each time a new rod was shrunk in. The danger of loss by the method he describes is so great as to render the method too risky to be recommended. Moreover, from the fact that each new rod had to be separately fitted to the head, it is evident that the method he describes entails an objectionable expense, which would be avoided by employing a method whereby a firm shrink fit would be insured repeatedly with standard stock rods having exactly the same sized tapered ends.

To remove a shrunk-fit rod end from a head of any kind, all that is necessary is to heat the head and rod end sufficiently, quickly cool the end of the rod without cooling the head and at the same time apply pressure upon the end of the rod to force it out quickly when it has shrunk sufficiently to permit. How to most advantageously do the several things specified in this statement is the problem which we are called upon to solve. It is desirable to effect the removal of the rod end with the smallest practicable expenditure of time and fuel, as well as to avoid injuring the metal by excessive heating and cooling, so the matter of how hot the head and rod end need be made is of sufficient moment to be worth considering. It is evident that the temperatures necessary will vary with the sizes of the rod ends to be removed—the temperature to which a head with a large rod end in it must be raised being less than that required for a smaller one. Let us consider that we have the removal of the end of an 8-inch rod, as specified by "Oil Stone," in making our computations of temperatures. Irons and steels of the compositions used for ordinary purposes expand and contract nearly the same under same changes of temperature, the co-efficient of expansion as given by several authorities being approximately seven-millionths (0.000007) of an inch per degree Fahr. While less than one-thousandth of an inch of looseness will ordinarily suffice for the withdrawal of a rod from a hole, especially if it be a taper fit, yet, owing to the probability that not all of the upset of the end has been removed by the turning off of the "bead," later referred to, and the fact that there will also exist a certain amount of roughness of the contact surfaces due to their "biting in" under the tremendous pressure of the shrink fit, we will assume that a shrinkage in the diameter of the rod end of 1-64 inch will be required to effect its removal. We will also assume that we will be able to reduce the temperature of the rod end to 200 degrees without reducing the temperature of the head materially while the rod end is being cooled. The difference in temperature necessary to produce 1-64 inch expansion or contraction in 8 inches of ordinary iron or steel—the diameter of the tapered rod end—will be

$$\frac{\frac{1}{64}}{8 \times .000007} = 279 \text{ degrees F.}$$

Adding to this necessary difference in temperature the assumed lowest temperature of the rod end when cooled down, 200 degrees, we have 479 degrees as the temperature to which the head should be heated. From this calculation it is evident that if we heat the head so that it will just melt a bit of ordinary half-and-half solder, which melts at about 500 degrees, it will be as hot as necessary, allowing for considerable loss of heat from the time when the heating is finished until the rod end

has been cooled and forced out. The heating of the head and rod end may be done in any convenient way, but the fire should be large enough and so arranged as to heat the outer portion of the head as much as or more than the central portion and rod end. The reason for applying the heat to the outer portion of the head is very evident, as by so doing the head is expanded more than the rod end, and less cooling of the rod end will be required to effect its removal. In fact, if some means of very rapidly heating the outer portion of the head were to be used, as by employing a suitable charge of Thermit iron applied as in welding operations, the head could be expanded and removed from the rod end before the rod end would be heated appreciably, and there would then be no need of the apparatus I shall describe for cooling the rod end. As such a means of extremely rapid heating is not often available at present, the reference to it is simply for the purpose of more intensely driving home the fact that the removal of the rod end depends wholly upon the difference in temperature between it and the head at the time the effort to separate them is made.

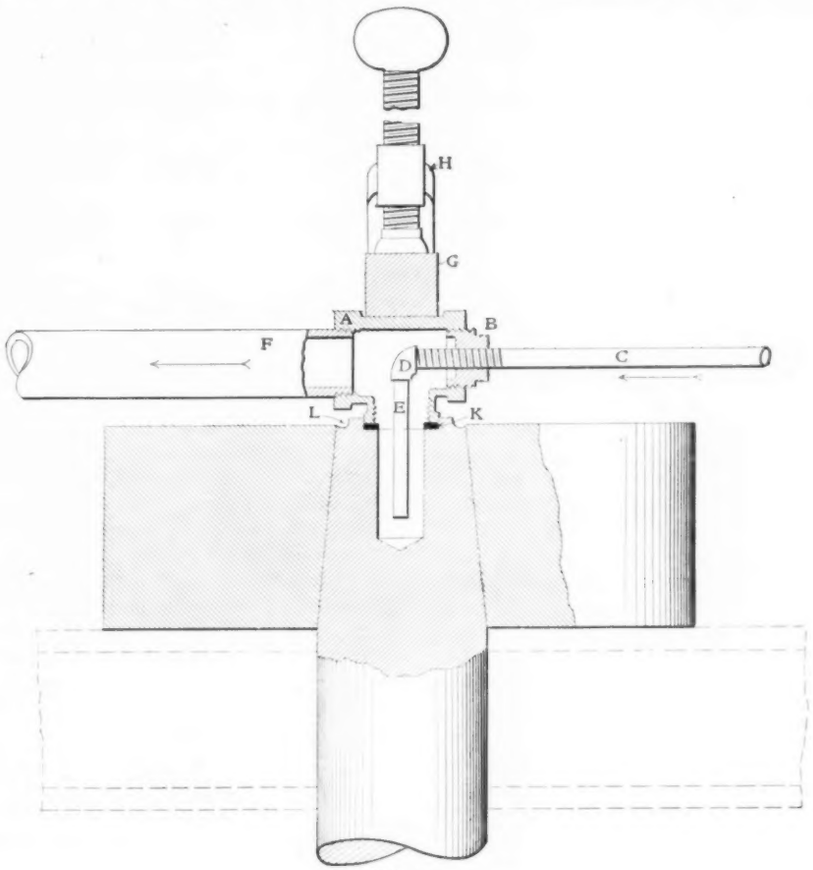


FIG. 1

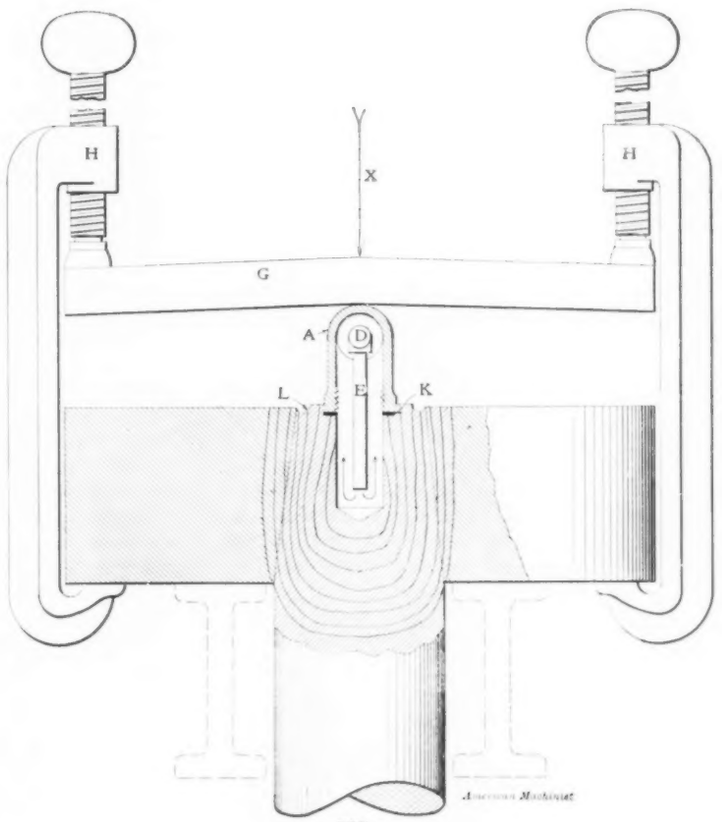


FIG. 2

REMOVING SHRINK FITS.

To effect the cooling of the rod end rapidly without cooling the head appreciably and at the same time to apply a heavy pressure upon the rod end to force it out as soon as it has shrunk enough to be removed, I should employ the simple apparatus illustrated by Figs. 1 and 2. Select for *A* a tee with side outlet preferably more than one-third the diameter of the rod end—in this case, say, a 3-inch tee having all openings of the same size. Secure a 3-inch nipple in the lathe chuck to carry the tee on and face the end and outside of the side outlet clean, irrespective of size. B is a regular stock 3x½-inch bushing, which permits of making up the long-threaded end of the ½-inch water pipe *C* and the elbow *D*, so as to have the other end of the elbow come central with regard to the side opening or the tee *A*, as shown. The nipple *E* is screwed into the elbow *D* after screwing *B* firmly into *A*. Screwed into the other opening of *A* is a piece of 3-inch pipe of a convenient length, which serves to confine and conduct away all the steam and hot water produced by cooling the rod end, thus enabling the cooling of the rod end to be done without permitting a drop of water to touch the head, and at the same time all danger of scalding the workmen with the steam and hot water produced is avoided. *G* is a strong bar of iron or steel secured in the position shown by strong clamps *H*. This bar *G* serves to bind the tee *A* firmly against the rod end and hold it securely in position in the recess shown, and at the same time it serves to transmit the considerable pressure which the strong clamps *H* exert directly to the rod end to push it from the hole the instant it is sufficiently loosened to permit. The joint between *A* and the rod end will preferably be made by compressing an asbestos washer *K* between them.

To most effectively cool the rod end it is necessary that the application of the

cooling medium be made at approximately the center of that portion embraced by the head. Drilling a hole of adequate size—in the present instance, say, 2 inches in diameter—to a depth equal to a little more than one-half the thickness of the head centrally into the rod end, affords access to the interior for the proper application of a jet of cold water. This hole can readily be drilled and the recess for securing the fitted side-opening of the tee *A* centrally upon the rod end can be bored out while the head and rod are in the lathe to turn off the upset or headed portion of the projecting rod end, as shown at *L*. The recess for centering *A* upon the rod end should be enough larger than the diameter of the faced side opening of the tee to insure the sure and quick insertion of same when the application of the apparatus to the hot head and rod end is to be made.

The nipple E should be long enough to insure directing the stream of cold water centrally to the bottom of the hole drilled into the rod end, as is clearly shown, so as to insure applying the coldest water at the center of the body to be cooled, and thus effect as equal a reduction of its temperature as possible. With the apparatus described and illustrated, the reduction of the temperature of the rod end by the jet of cold water will be as approximately shown by the series of contour lines about the cooling jet upon the rod end and adjacent portions of the head, as shown in Fig. 2. From an inspection of Fig. 2, it is evident that the temperature of the rod end may be very effectively and rapidly reduced, by the method I have described, while only the immediately adjoining portion of the head will have heat extracted from it by the water. As the outer portion of the head will only lose heat by atmospheric radiation while the rod end is being cooled, it is evident that the head will shrink but very little in diameter during that time, while the rod end will shrink much more rapidly in diameter from its more rapid loss of heat to the cold water, and thus the desired difference in temperatures necessary for the loosening of the rod end will be effected and the rod readily forced out by the pressure applied to same by bar *G* and clamps *H*. Should the rod end not be forced out by the means described after the jet of cold water has been applied for a reasonable length of time, the water may be shut off for an instant and a hard rap with a sledge upon bar *G*, as indicated by arrow *X*, in Fig. 2, will probably suffice to effect its instant dislodgement.

It is of course understood, in connection with the apparatus I have described, that a hose forms the connection between the water supply and pipe C, with a valve properly placed so that the flow of water may be under control and immediately shut off when the rod end is forced from the head, also that the discharge pipe *F* is properly arranged to discharge where it will do no harm.

By using this method of removing the rod end it is evident that a single heating will suffice for the removal of a rod end and the shrinking in of a duplicate, as it will take but an instant to put the apparatus aside, turn the hot head over on the rails and drop a new standard stock rod into the clean, undistorted hole from which its predecessor was removed a few seconds previously. The heads will be subjected to but a single comparatively light shrinkage strain each time a rod end is removed and another one shrunk in and the liability of cracking them very greatly lessened. All expense of reheating and special fitting of rods each time a new rod is to be shrunk in will be saved, while the apparatus is simple, inexpensive, and but few sizes will be necessary for a wide range of sizes of rod ends.

In connection with this subject, it may not be out of place for me to relate a practical experience I had, several years since, in assisting in freeing an idler that had heated and firmly set on its stud. A practical and experienced engineer, much older than myself, had bought a fine new traction engine. It was a fine, well-built machine. The buyer was bringing his purchase home from the railroad station under its own steam. He was proudly piloting his new charge through the streets, when, with a few squeals of warning, one of the large toothed idlers that transmit the power from the main shaft to the drivers set firmly on its stud and brought the engine to a sudden stand-still immediately in front of the house where I was then living. I found the engineer and his assistant had removed the cap that held the idler securely on its stud and were trying to force the hot hub off the still hotter hollow stud. By using a heavy bar as a pry and exerting wrenching strains upon the wheel they had succeeded in moving it about an inch in the direction desired; but there it stuck so firmly as to defy their utmost efforts to move it. At this opportune time I ventured to suggest to the engineer that I could help him out of his difficulty with a small piece of ice or a stream of cold water to cool down and shrink the hollow stud away from the hub. He looked at me with a sort of what-do-you - know - about - practical - engine-running expression on his face, for he judged that I was some "counter-jumper" or bank clerk rather than what I really was at the time—first assistant draftsman in a near by engine works. After watching the futile efforts of the engineer and his assistant for a few moments after making my suggestion, I went into the house and procured a piece of ice about as large as the crown of an ordinary derby hat. When I appeared with the ice, the engineer seemed to think it was "up to him" to apply it, and he broke the ice into several pieces and immediately began applying them to the outer surface of the hub, which hissed and shrunk tighter upon the stud. I protested that he was making matters worse instead of better by that treatment, and finally he yielded and permitted me to carry out the plan I had suggested. I broke the ice into small pieces and filled the hollow stud full of them. The stud was so hot that the ice melted very rapidly, and I kept putting in ice as fast as it melted away. In less than three minutes after I began applying the ice to the hollow of the stud it had cooled so as to nearly stop "sizzling," and upon the engineer's placing a hand upon an arm of the idler and giving it a slight push, it slipped back to its shoulder and was perfectly free, to his great surprise and pleasure. He then thought to improve matters by cooling off the hub, which was still very hot, and began applying the remaining ice to same. To this I protested, and he yielded. I then told him to put plenty of oil into the bearing and keep the ice in the stud so long as it should last and he would have no further trouble. This he did, and after replacing the cap he had at first removed, he started his machine off down the street and disappeared from sight without further trouble—a practical engineer having a higher regard for the actual worth of ideas gained from other sources than actual experience.

Pistons and Packing Rings.

BY AMOS PRICE.

At a recent meeting of an engineers' society the discussion of the topic indicated by the heading was continued from a former meeting. One member, whose intention was to get at the bottom of the subject, stated that a piston is a sliding partition in the cylinder separating the live and exhaust steam, in the case of a steam engine, and the high and low pressures in piston pumps, air compresors, etc., and that it is only necessary to make the piston itself strong enough to resist the strains due to the differences in pressures, plus a reasonable margin and as near the diameter of the cylinder as practicable. The packing rings then do the rest—that is, they make a joint between the cylinder and the piston, not in the sense of a copper gasket between steam chest and cylinder, but like a safety valve and its seat, as regards the ring and piston, and like a slide valve and its seat, as regards the ring and cylinder, as shown in Fig. 1. Of course the groove is shown here much too wide for the ring, to make it clear that the steam can get under and force it out to the cylinder, and also press it to the piston, the live steam acting in the direction of the arrow. These conditions exist during the life of the ring, except that the area of contact between ring and piston is reduced by their wear, and also that of the cylinder.

The question at what part of the stroke does the packing ring change to the opposite sides of its groove was allowed here and to it the speaker replied in substance that it was probably when the pressures on the opposite sides of the piston were

equal, as they would be when the expansion and compression lines crossed, as at *a* in Fig. 2. (The figures are copies of blackboard sketches.) This assumes that the friction between ring and cylinder and the ring's momentum are equal at that point, leaving the ring, in regard to the piston, in equilibrium. If the change occurred at any other part of the stroke, some steam would flow around the ring

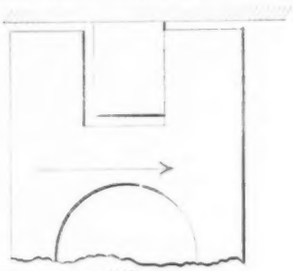


FIG. 1

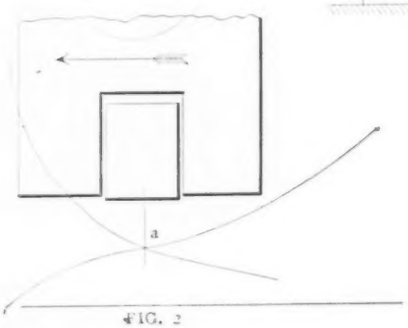


FIG. 2

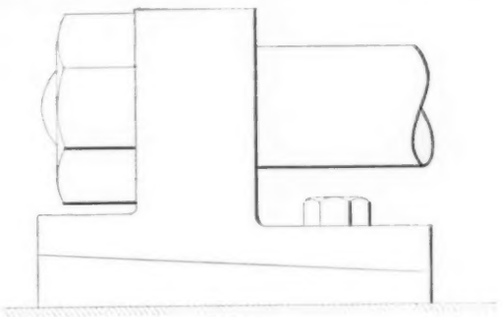


FIG. 3

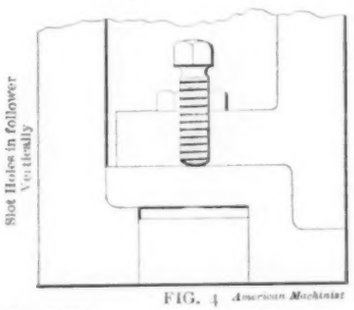


FIG. 4 *American Machinist*

PISTONS AND PACKING RINGS.

while doing so, however trifling the quantity might be. That rings do change from side to side of the groove is proven by the click heard near the end of each stroke, also by the groove wearing wider and the ring narrower, due to impact. He believed that it was good practice when the weight on the cylinder was 100 pounds and over to support the piston with a tail rod resting on a guide, as in Fig. 3. He made his packing ring, using only one to the piston, as narrow as the conditions would permit. Thus, if the ring traveled ¼ inch over the bore of the cylinder and the piston had ½ inch clearance, he would make the ring ⅜ inch wide, so that there would be no chance for it to get into the steam port as long as the cylinder head was intact. See Fig. 5. If the over-travel was ⅛ inch and the clearance the same, he would make the ring ¼ inch wide, and in all cases he would provide them with a joint cover, to prevent leakage at the cut. (The joint cover implies that he used a snap ring.) The object in making narrow rings was that they wore the cylinder less and did not require as much oil as wider ones.

Several of the members objected to the tail rod, on account of its extra cost, and the additional room the engine would occupy, and maintained that pistons of the Fig. 4 type were O. K. The head can be adjusted at any time by removing the cylinder head and follower, and a new packing ring is as readily put in as in any piston made; besides, if the ring is doweled to the piston with its cut at the bottom of the cylinder, no joint cover is needed.

Concentric rings, whose thickness is 3 per cent. of the diameter of the cylinder, and breadth determined by the piston's clearance in the cylinder, and the ring's over-travel, and turned 1 per cent. larger than the bore of the cylinder, were recommended for engines over 10 inches in diameter, and eccentric for that size and under. The eccentric rings for small sizes were more elastic and could be sprung into the grooves with less liability of breaking. One member strongly objected to eccentric rings for any size, owing to their rapid edge wear at the thin part, making it necessary to face the grooves each time a new ring was put in. He found that if concentric rings were warmed and expanded slowly with a "hat stretcher," shown in Fig. 6, no difficulty was experienced in slipping the rings off the expander on to the piston. In experimenting with cast-iron rings, he found that by heating a 9-inch ring to redness and expanding as much as he thought it would bear, then allowing it to cool, reheating and re-expanding three times, made it fit an 18-inch cylinder. A 9-inch ring 1-100 inch thick would not only straighten out, but could be turned wrong side out without showing any signs of breaking. Concentric rings that are made of the proportions as above, if cut and sprung into a round cylinder, do not fit it all around at the time they are put in; but if left standing at a temperature of boiling water for a few hours or days, according to the grade of iron they are made of, will do so. One of the peculiarities of cast iron, especially when in lengths and cross-sections such as packing rings are made, is that it will accommodate itself to a variety of "permanent" shapes if carefully handled. The only advantage the eccentric ring had was its less liability to break.

The member who had favored supporting the piston with a tail rod called the club's attention to an objection he had to pistons made like Fig. 4. He believed that such pistons needed a counterbalance as much as a slide valve. While the area of contact between the bottom of the cylinder and piston is less than that of a slide valve, the speed of the piston is much greater, and the friction losses correspond, to a great extent, with the velocity of the sliding surfaces. Of course live steam can only be effective on one face of the piston at a time; to be exact, from the face of the piston to the packing ring only. This distance multiplied by the chord of the arc of contact, and again by the live steam pressure, plus the back pressure, to which should be added the weight of the piston and a part of the piston rod, gives the total load on the cylinder. In case a tail rod is used, no part of the piston except the packing ring touches the cylinder, and consequently it must be steam balanced. This reduced the cylinder wear and friction to that of the packing ring, which if made as narrow as the conditions would allow, or, better yet, if the engine is designed with that end in view, is so small that it may be overlooked. Narrow rings, being lighter, did not hammer the piston grooves as hard nor so loud as heavier ones did, nor were the former so liable to break. He would as soon think of making a 10-inch globe valve with a seat ten times as wide as an inch one as of making any packing ring wider than the circumstances called for. While these remarks were greeted with some applause, it was soon discovered that it was intended only for the packing-ring sentiment,

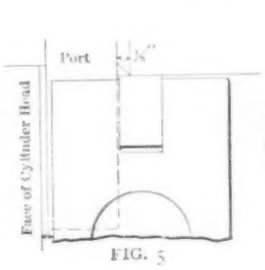


FIG. 5

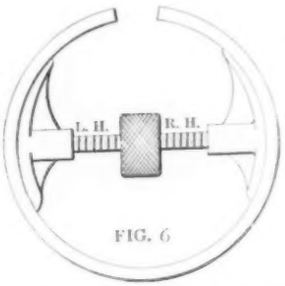


FIG. 6

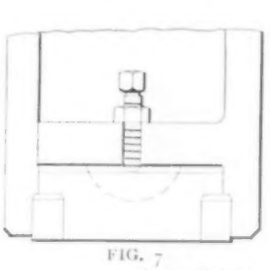


FIG. 7 *American Machinist*

PISTONS AND PACKING RINGS.

for his piston theory was not generally concurred in.

One member, who held an opinion contrary to that of the last speaker, indulged in some irony, by saying that he had not found it necessary to pry up a piston to let air under it before pulling it out of the cylinder, nor had he been compelled to hitch counterbalances to his feet to lift them from surfaces when shod with shoes favorable to forming a vacuum between them and what he stood on. Neither had he heard of men while working beneath a load of several atmospheres, as in sinking caissons for bridge piers, having trouble to support an unbalanced weight, nor being compelled to minimize their contact with mother earth. It used to be thought that there was a partial vacuum between the belt and pulley, giving the belt a pressure on the pulley in addition to that of its tension, but when the belt was found to slip on the larger pulley, as it usually does when it is the driver, the vacuum theory had to go.

The president thought that the comparisons which had just been made were not relevant, nor did they fairly represent the conditions. A man walking is surrounded with a constant pressure, while a piston is subject to rapid changes of as much as ten or fifteen atmospheres. Suppose one were to shoe himself with surface plates, and start out to take a walk on a pavement made to match, when, presto! the pressure changes 150 pounds per square inch. Well, under these conditions the pedestrian will stop till he can change slippers, or until air leaks between the surface plates and destroys whatever vacuum may have been there. We should find walking very difficult with a variation of only 1 pound pressure, if the changes took place when the foot was being lifted. To get the best evidence of the changes of pressure, the shoes should be rubber and the pavement wet. It would not be consistent to suppose that steam sets a packing ring to the cylinder and that the piston itself is not similarly affected. He was opposed to a tail rod, believing that the friction of the rod in the stuffing box and supplemental bearing at the end would so nearly equal that of the piston on the cylinder that no appreciable economy would result. He would bush the cylinder with hard cast iron, and make a two-ring piston, as in Fig. 7, with the piston resting on the T-ring, which is not exposed to live steam, therefore the piston has no steam load to carry.

I do not believe that the packing ring will change sides in its groove when the pressures on both sides of the piston are equal, but when the total pressures on each side of the ring balance each other. The difference between the area of the cylinder and that of the piston is all there is of exposed surface on one side, while on the other its entire surface is subject to the pressure on that side of the piston. Suppose these areas were as 10 to 1, then the ring would change, not as shown in Fig. 2, but when the compression pressure is ten times that of the expansion or exhaust pressure.

Echoes From the Oil Country — Making a "Straw Boss."

BY W. OSBORNE.

Ben was a quiet, level-headed, somewhat easy-going man, but he was a square, honest one that could be depended on, and he was a good machinist. He had worked for Grey, Brown & Craft for nearly a year, and had never had any particular reason to complain of the treatment that he had received; at the same time he had no reason to think that he was held in any high esteem. He was somewhat surprised when he was called into the office and told that he had been looked upon as a possible solution of the problem as to who the new foreman would be. While the old foreman was still looking after the shop, it was well known that he had another place and was going to leave as soon as his notice was worked out.

It might be hard to tell just what Ben's ideas were on the subject. It is more than likely that he looked on this as he would have done on any other job that they set him at. He had been used to going at any job that the firm he was working for told him to for so many years, and doing his best at it, that perhaps it did not strike him that this was a different sort of an undertaking. At least he followed up the idea that he had a right to accept any job and any degree of responsibility that the firm saw fit to entrust him with. However that may be, it was soon known throughout the shop that he was to be the next foreman. The outgoing man was very good in doing what he could to make it easy, and as Ben knew all of the men, and had been around long enough to understand what was wanted as to the grade of work, he took hold under very fair conditions.

Stepping up from the ranks by a selection that was not his own act was different from looking up a bossing job because it was wanted, and because the man who looked for it thought that he was fitted for it and would be a success at it. It was with a feeling of diffidence that he began to give orders, and he almost felt under obligations when a man received them cheerfully and went to work with a will to carry them out. It was hard work to go to a man that he had been the best of friends with and insist that he do his work in a different and more workmanlike way, and it was harder yet to go again when that friend did not see fit to make an effort in the desired direction, and give him to know that orders must be followed or a spot would be made for someone else.

Perhaps those friends did not mean to do anything that would hinder Ben; I rather think that some of them felt that they were doing him a favor by their actions, by not doing work as he desired, by telling others to do it a different way from what he had told them and it is likely they would have been indignant if anyone had accused them of trying to take advantage of former friendship. However that might have been, it did not take even Ben very long to understand that he did not get the results from some of his friends that he should have gotten.

While Ben began to realize that things were not as they should be in this direction, and saw the need of taking a stand, there were some other things that were bothering him still worse and filled his whole atmosphere with uncertainty. Grey, Brown and Craft were all good, competent mechanics. Any one of them could have made a success of being foreman. They had been drawn together by the law of affinities that seems to make opposites attract. Their differences seemed to harmonize so well that they seemed to suit each other and made a good business combination. Nominally, Grey was the head of the office, Brown was head of the mechanical end of it, while Craft hustled for contracts and did the outside work. Practically each one of them was in the habit of doing some of each kind of work. Each one of them felt that Ben was an experiment for which he was, to some extent, responsible. Each one spent a good bit of time seeing that Ben kept on the right track. Had they all been made from the same pattern, from the same material, and cast in the same kind of a mold, they might have worked nearly the same, but as it was each one had his own different idea as as to how Ben should handle things, and this is where it was making trouble.

Grey had taken the office work because it suited his make-up. Figures are positive things that will give exact results (whether the story they tell is exact or not is another consideration) and the quiet, methodical way that did not involve the making of all sorts of allowances for men and machines, went with them. Grey carried his office ideas, unconsciously perhaps, into his judgment of Ben, and he directed his advice and criticism along the same lines. "Hold them right down where they belong, and do not let them get slack in the details," he would say.

Brown was different: he realized the value of time and did not want things to pause. He also realized the importance of selecting the right man for the job. He did not seem to realize the importance of letting Ben have time for the experience of these things to bear fruit; besides that he knew Ben too well, and while he feared the result of his weak points he did not give him proper credit for the strong ones. "Change Andrew to that job; it will take Morris forever to get it done. He does not seem to know what he is about." Mr. Brown did not know that the uncertainty

was caused by criticism of Mr. Grey, who had been there a few minutes before.

Mr. Craft knew the impossibility of driving people to buy, and he was a good salesman. "No use to get too rash, Bennie, my boy. You can lead and coax people where you can't get them any other way." That was his way of helping Ben when he chanced along at a time when Ben had thought it necessary to inform a man rather energetically that things must be different or that there would be trouble.

With no real respect shown for him by

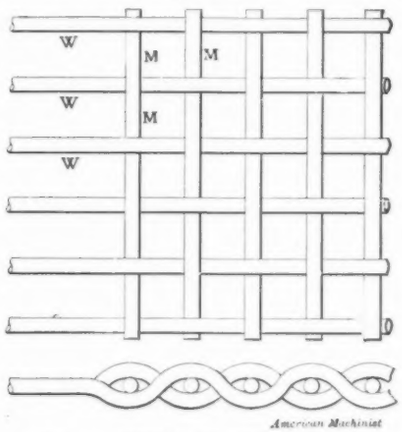


FIG. 1. SECTION OF WIRE NETTING.

those above him, can it be any surprise that Ben often heard remarks about "a straw boss," or "a dummy to take the damning?" The harder he tried the more it seemed that things did not come his way, and, while he did not have the matter arranged very logically in his mind, he felt that he was a failure under the conditions, and when he overheard one man tell a new arrival: "You just watch the owners, especially Brown. Never mind the foreman; they only keep him here to look at," he went into the office and resigned.

The firm did not seem in the least surprised, but asked him to stay for a few days until they had a chance to look around a little; this he agreed to, and one day soon after he was called in to meet a man that the firm thought would suit them. This man had been around the shop for some little time with Mr. Brown, but Ben had not thought from his actions that he was the coming man.

This man was talking to the members of the firm as Ben walked in, and he could not help hearing the concluding remarks, ". . . . find me always willing to carry out any orders that you may give me, so long as it is clearly recognized that there is no authority that in any way interferes between me and the men. I am responsible to you gentlemen, but the workmen in my department are responsible to me, and to me alone. Anything else is not fair to me or to the men." And they did not seem to resent being talked to in that way.

Don't condemn Ben too harshly; next to knowing a thing comes the ability to learn it, and the men that have worked for him over at Minter's do not have any complaint of a straw boss, or of a kicking post or figure head, and Minter knew all about his failure at the other place before taking him on.

Oh, yes, the new man got along at Grey, Brown & Craft's. He insisted on having his proper place from the beginning, and is careful that it is not encroached upon. Over at Minter's Ben does not have to do any insisting. All of the insisting that is necessary to be done in that line is done by Mr. Minter himself, but it is done so quietly that it is not noticed by the men.

Making Wire Netting.

Chas. W. James, of 4140 Parrish street, Philadelphia, has invented a machine for making wire netting which embodies some interesting examples of wire-working devices.

Fig. 1 shows a small portion of wire netting such as made by the machine and appurtenances here spoken of. [The cuts with the article are not all to the same scale.] This sample was of 3-16 inch wire and ¾ inch center to center. It may of course be made of other sizes of wire and with other spacing, the dies being provided to correspond. Throughout this paper the continuous wires, or the wires running lengthwise, will be designated by the letter *W* and the cross-wires by the letter *M*.

For this operation a special press movement is required, and this is indicated in Fig. 2. It is necessary that at each end of the up and down strokes of the ram there shall be a cessation of motion long enough for the cross-wires to be inserted, and this is accomplished by the cam *Z* with the concentric face. This cam operates between rollers the lower of which runs in bearings on the sliding head or ram *C*, the upper roller being journaled in yokes *B'* connected to *C* by the upright studs *C'*. The springs operate to take up the slack which might otherwise occur between the cam and the rollers on account of the varying diameter of the former.

Fig. 3 is an outline sketch showing the ram *C* and bed *D*, each with its set of dies. In this view the ram *C* has reached its lowest position, where it remains for a short time. The looping dies *H* have looped the length-wires *W* up and down

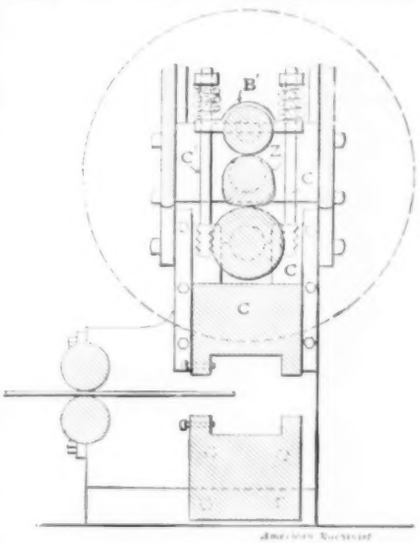


FIG. 2. SECTION THROUGH CENTER OF MACHINE WITHOUT DIES.

alternately, forming a shed of up-and-down loops extending across them all.

The dies *H* have a groove cut in the centers of their ends, forming a passage through which the cross-wires *M* are fed. The result is that the cross-wires *M* also pass between the sheds of loops, thus accomplishing the weaving.

Fig. 5 shows the dies closed and the

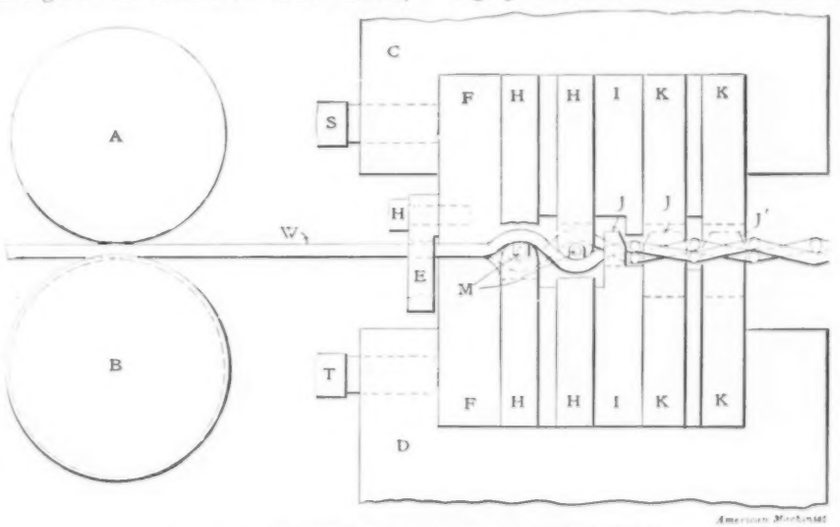


FIG. 3. RAM AND BED WITH DIES AND FEED ROLLERS.

looping of the length-wires *W*, with the cross-wires *M* inserted. It also shows the shearing knife and die. The cross-wires *M*, before going through the grooves in the looping dies, pass through holes in the shearing die, and over the cutting edge of the shearing knife. When the ram *C* rises, the shearing knife cuts off the cross-wires from the long lengths at the face of

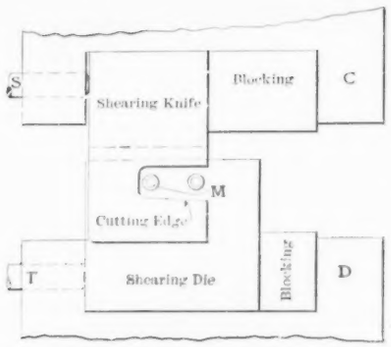


FIG. 4. END OF RAM AND BED.

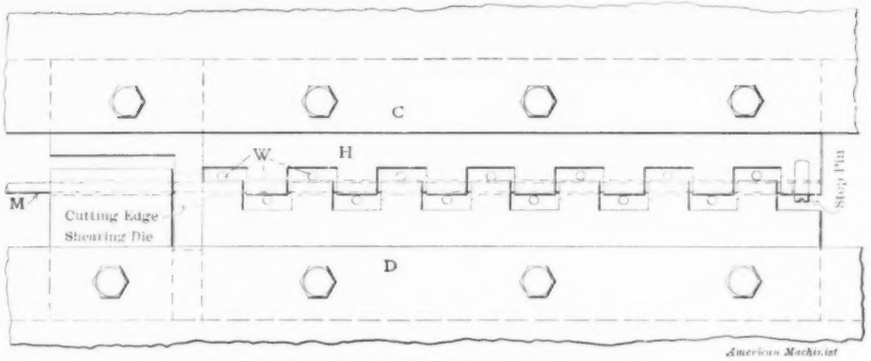


FIG. 5. FRONT OF RAM AND BED WITH DIES.

the holes. The shearing knife is open on one side, so that the cross-wires *M*, after they are sheared off and woven in, can be moved back through the machine along with the length-wires when moved by the feed rollers. The face view of the shearing arrangement is shown in Fig. 4.

A wire spacer and lift-bar *E* extends across the front of the dies. A front view of a short portion of it is shown in Fig. 6. It has a number of oblong openings equal-

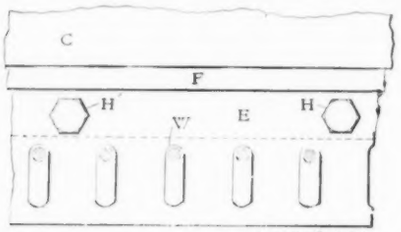


FIG. 6. WIRE SPACER AND LIFT-BAR.

ly spaced throughout its length. Through these oblong openings the length-wires *W* pass on their way from the feed rollers *A* and *B*. The function of *E* is to keep the length-wires *W* equally spaced and to free the wire from the dies, after it is woven, so that it can be moved on through the machine. As ram *C* rises lift-bar *E* rises also, but the wires *W* do not rise—owing to the oblong holes—until plunger *C* has risen about half its stroke. This allows the top dies to free themselves from the wire. Now, during the remainder of the upward stroke of the ram *C*, the wires *W* have come in contact with the bottoms of the oblong openings, and as the bar con-

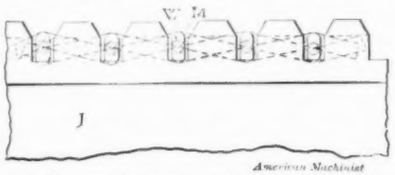


FIG. 8. SPACING BAR FOR LENGTH-WIRE.

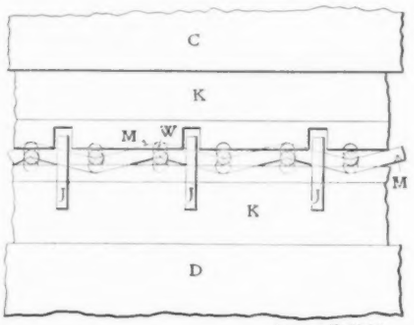


FIG. 9. SPACING BLADES FOR CROSS-WIRES.

tinues to rise, it lifts the wire free from the bottom dies also, thus centering it between the two sets of dies, as shown in Fig. 7, when it has been moved forward in the machine by the feed rollers. These feed rollers are located far enough away so that when the lift bar *E* raises the length-wires *W* it will only spring them and not put a set in them.

J is a spacing bar, having equidistant notches to receive the wires *W* and keep them in correct lateral position. It runs

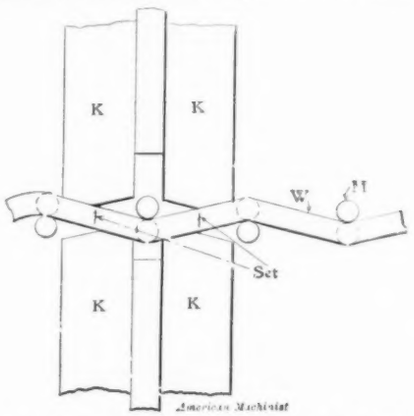


FIG. 10. SHOWING HOW THE WIRES ARE SET.

the length of the dies, Fig. 8 being a front view of a short portion of it, the projecting ends formed by the notches being beveled so as to catch the length-wires *W* as they descend with the ram *C*. Fig. 7, and center them where they are locked by the tightening dies *K*. These tightening dies *K* depress the length-wires *W* down on the cross-wires *M*, crimping the latter and also putting a more perfect crimp in the length-wires themselves, thus locking both sets of wires with one another, as shown in Fig. 3. Spacing blades *J'* set in the tightening dies *K* to center the cross-wires *M*, the same as the spacing bar *J* does the length-wires *W*. A side view of them is shown in Fig. 9.

The feed rollers *A* and *B* are intermittently rotated when the dies are opened, bringing forward another portion for the dies to act on, the wires *W* coming from the feed rollers all on the same horizontal plane. Then the ram *C* descends with the lift-bar *E*, and the wires on meeting the spacing bars *J* and *J'* are centered over the dies where they are acted on by the dies, the wire being crimped, and two more cross-wires fed in. Ram *C* rises, shearing off the cross-wires, the lift-bar *E* again centering the work to be moved by the feed rollers for another operation.

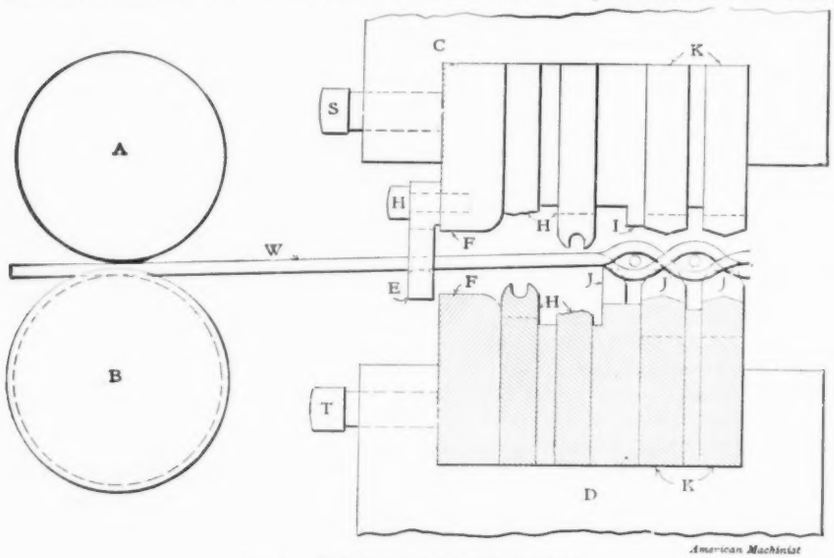


FIG. 7. READY FOR DESCENT OF RAM.

The mechanism for working the feed rollers is not shown, but they receive their motion from the end of the power shaft by familiar cam and ratchet movements.

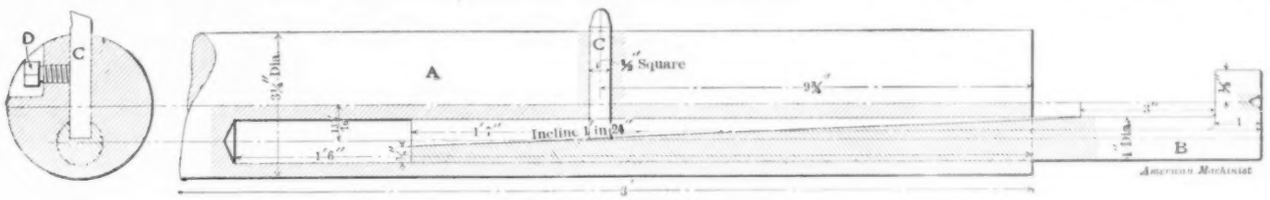
Looking at Fig. 7, it will be seen that the tightening dies have a surplus of wire to deal with. It will also be seen that the looping dies need more wire to make the loops. So the surplus wire from the tightening dies is transferred backward to the looping dies, to be used in forming the loop.

When the tightening dies come together on the length-wires, pressing them against the cross-wires so hard as to crimp them, it is evident that they could not bind any tighter. As the tightening dies press on the length-wires, top and bottom between each cross-wire, it puts a set in the length-wires halfway between the cross-wires, thus keeping them hard against the cross-wires after the dies leave them. A sketch of this is shown in Fig. 10, in which is only one length-wire, to show more clearly how the set is put in the length-wire.

Boring Bar for Taper Holes.

We clip the accompanying description and illustration of a boring bar for taper holes from *The Mechanical Engineer*, of Manchester, England:

The illustration shows the construction of a bar for boring taper holes. The bar *A* is held in a chuck at the left hand. The right-hand end (or lower end if used in a vertical machine) is bored out eccentric and fitted with a rod *B*. This rod has an enlarged end in which fits a center, on which it is steadied when rotating. It has also an inclined groove cut in it, this incline corresponding to the amount of taper required. A single cutter *C* is used, and the end of this fits in the groove in rod *B*. Thus, when the bar is fed along, the rod *B* is prevented from endwise movement, and the cutter is therefore compelled to travel up the incline in the rod. A set-screw *D* is tightened on the cutter just sufficiently to prevent it digging into the work.



BORING BAR FOR TAPER HOLES.

A meter is about 39⅓ inches, or a little more than 3¼ feet. A kilometer is very nearly ⅝ of a mile. A gramme is approximately 15½ grains. A litre is but a shade more than a liquid quart. The metric ton contains 2,204 pounds. The Russian verst is a few feet longer than a kilometer. The Russian pood may be figured as the equivalent of 6 pounds avoirdupois. A cubic foot of water weighs 62.5 pounds.

Patents Which Obstruct.

The following paper, reproduced nearly in full, was read before the Technical Society of the Pacific Coast by Geo. W. Dickie, general manager of the Union Iron Works, of San Francisco, Cal.:

Patents appear to have had their origin in the ancient practice of giving to favorites monopolies or special privileges in connection with the making or vending of such things as they dealt in by the reigning prince in absolute or restricted monarchies. This evil practice worked great hardship on the less-favored body of purchasers and consumers, and trade was thereby greatly restricted. The British people forced from the unwilling James I a statute declaring void all these burdensome monopolies, with the distinct exception regarding letters patent and grants of privilege as follows: "Sole working or making of any manner of manufacture within the realm to the true and first inventor of such manufacture, which others, at the time of making such manufacture, should not use, so they be not contrary to law, nor mischievous to the state by raising of the price of commodities at home, or hurt of trade or generally inconvenient." These words form the foundation upon which has been built the whole structure of the law of letters patent.

The inventions for which patents are granted are either vendible articles, such as machinery or apparatus, or processes. A mechanical principle cannot be the subject of a patent unless its application to some useful end be shown. The principal classes of patents seem to be granted on:

First—New contrivances that produce new results.

Second—New contrivances that produce old results.

Third—New combinations of old and well-known parts, whether the combination relates to the operation or to the result.

Fourth—New methods of applying a well-known device.

The spirit of the patent law is that the benefit or improvement must be manifest and of importance with regard to claims for patents touching well-known objects and processes, and great skill is sometimes displayed in so wording a specification as to bring this requirement into prominence, the object of the law being that the rewards to come to the patentee will be a just recompense to him for his labor in the wide sense that though his labor may not in itself have amounted to much, though the change in process or application be small, still, if the general scope and utility of application or process, or whatever the patent may cover, be enlarged to the benefit of the public, the inventor (though in this case only an improver) is entitled to a just reward for his discovery, and this reward his patent gives him an opportunity to secure. In the case, which often happens, of a party making some discovery not already patented, but openly used by someone else, though not to his knowledge, no patent is allowable, but should the discovery have been previously made and be kept secret, then the party who first obtains a patent is the legal inventor, irrespective of priority of invention on the part of any second party. In Great Britain a patentee may be compelled by law to grant licenses to persons to work his patent should they be able to prove that the public is being defrauded of the use of the patent.

The whole reason for the existence of patents is the monopolizing by the inventor, for a limited period, of the benefits derived from an invention, on the supposition that there will result a lasting benefit to the public after the term of the patent has expired.

A very small percentage of the patents granted meet this condition, for, to do so, they must cover real inventions. The mechanical arts have reached such a stage of development that new combinations of mechanical devices, in the sense of invention, are hardly possible, and, in my opinion, a patent should be issued only where some new contrivance has been invented to produce a new result. I would not have any real inventor go unrewarded, but, in order to recompense the few inventors who have done work worthy of recognition by their fellow-men, it should not be necessary for the public generally, and the mechanical arts in particular, to carry the huge load of patent-protected devices of all sorts described in patent specifications, which, owing to cleverly worded claims, prevent a free application of the proper device to accomplish the end in view.

I have reached my present position on the patent question through experience in my daily task of continually seeking the best mechanical means to accomplish the end in view. In order to illustrate the kind of patent that stands in the way of progress, seeking to exact royalty on claims that should never have been allowed, I may cite a case where the holder of a patent is at present claiming damages from the company with which I am connected for alleged infringement of the

claims on which he has been allowed a patent:

In 1898 the United States Navy Department issued specifications for three battleships. On page 37 of that specification there is the following requirement: "Lifting gear to be provided for all armored hatch covers which can be worked by hand power from above and from below. Such shutters and doors of armor as may be directed are to be fitted to be opened and closed by electric power, the electric power appliances to be worked without disconnecting the hand gear." And on page 49 there is the following requirement: "The principal sliding water-tight doors below the protective deck, as directed, to be operated on an approved system by power, each such door to be capable of being operated by hand or power from either side, and all to be capable of being closed simultaneously from a distance by power from two stations located as directed. The distance control must not incapacitate each door from operation on either side at the door by power."

A company had been making doors for such use under patents. These were at first hydraulic doors, but after some experience with them new patents were obtained for doors operated by air, and now this company has bought or otherwise secured patents for doors operated electrically. The claims under these patents are all very broad and cover the combination of a door, the bulkhead to which the door is secured and the mechanism for operating the door. Now, bulkheads are not new, doors secured to bulkheads are not new, and mechanism to operate doors attached to bulkheads is not new. But to come back to our case: In October, 1898, the contract for one of these three battleships from whose specification I have quoted was awarded to the company with which I am connected, and, after the more important matters connected with the beginning of such a contract were attended to, I began to consider how I would meet the requirements of the specification as to doors and hatches to be operated by power.

Some time in December, 1898 (exact date unknown, for we never consider that what we do at any time may be required as evidence in a patent case), I talked this thing over with our electrician and decided to operate these doors and hatches by electric motor, using the ordinary vertical sliding door frame and screw, simply taking the doors we had been making for years, applying a special motor to operate the screw and using the control devices that we had used for other purposes, it never occurring to us that any invention was required to meet the case.

We could not start the plans for these doors for some time, owing to press of other work. I find, however, that on February 13, 1899, I wrote the president of our company, who had sent me a proposed plan from the other company offering their hydraulic doors for use in this battleship, as follows: "The number of vertical sliding doors for the ship has not yet been determined, nor what number of them should be operated by any power system at a distance. Our intention is to devise an arrangement for operating them by electric power, and we will take it up as soon as we can possibly get at it. The prices given for these doors are altogether too great to make it advisable to think of using them." About this time I think that we must have begun to make plans for these doors, as the contemplated plan was signed and dated May, 1899. A sample door was made, and a sample portion of bulkhead to which the door was attached, the bulkhead being in the form of a tank to test the water-tightness of the door. This was set up in the shipyard some time about July, and the door was thoroughly tested and found to operate very satisfactorily. Here, again, I cannot fix dates, for it never occurred to me that I was inventing anything and that evidence would be needed to establish who the inventor was, there being nothing new about any of the devices used. When the door was found satisfactory, the plans were submitted in the usual manner and approved, and the work was started.

In November, 1899, I was in New York, attending the meetings of the Society of Naval Architects and Marine Engineers, and there learned that the naval constructor at the New York Navy Yard had been getting up an electrically operated door to meet the requirements of the specifications from which I have quoted, and had a sample one set up at the yard. He invited me over to the yard to see his door and note in what way it differed from the one I had designed, so I went to see it and found that it also consisted of a combination of well-known devices, although differing from mine. He used a rack on the back of the door instead of a screw, the pinion gearing with the rack being carried on a shaft, which also carried a worm wheel, in which the worm on the motor shaft geared. This was not so simple as the motor direct on the screw, as I had it, and has not proved so effective. We talked freely about the difference in the doors, each trying to show the other where his door had the advantage, but neither said anything about being an inventor.

About a month after this the naval constructor made application for a patent on his door, with broad claims covering the combination of a bulkhead, a sliding door and motor, with controlling devices for operating the door. This patent was granted in 1900, sold or assigned to the before-mentioned company, who have started suit against the company with which I am connected for a large amount of damages and injunction against using the door I got out to meet the requirements of a government specification. It may be said that such a suit will not be successful, but it will cost the company several thousand dollars for its defense.

I have stated this case at length because it is the best illustration I have at present of the kind of patent business that should be stopped. In this case (and it is representative of ninety-nine cases out of every hundred) there is no invention required. The door is the same as has been used for many years. The wedges that force it on the face when it reaches the proper position are the same as have always been used for that purpose. The screw that works the door, either vertical or horizontal, is the same as has always been used. When operated by hand it could be operated either at the door or at a distance. By and by a specification requires it operated by power, and I decide to do it electrically. For this purpose I use a motor such as we had used for telemeter purposes, gear this motor properly to the screw that operates the door, use well-known devices for controlling the movements of the motor, both at the door and at a distance, and in doing this it never occurred to me that any invention was required to combine these various well-known devices. At the same time a government officer, knowing what this specification required, also took a door, such as had been used for many years, with the wedges to force it on the face when it reached the proper position, discarded the screw that had so long been used to work it by hand, fitted a rack on the door, a pinion to work in the rack and a shaft with a worm wheel on the shaft—a motor with a worm on its shaft to work in the wheel and with well-known controlling devices at the door and at a distance. After his door was finished it occurred to him that he had invented something in connection with it, and he applied for a patent with claims covering the whole combination. The patent was granted and then sold or assigned to the company that brings suit to recover damages from others who had the door in operation several months before any patent was applied for. Had I thought anything was being invented when designing this door, I could have applied for a patent several months before the other. Now an expensive defense must be made against the claim of the party holding this patent, although, if invention were necessary to the securing of a patent, this party could not have obtained one.

I do not wish to be understood as opposed to all patents. I believe in rewarding everyone who by invention or skill, succeeds in making new combinations of well-known devices to accomplish results whereby the public will be ultimately benefited, and I would have such rewards liberal and sure; but patent claims cleverly worded to cover combinations of well-known devices—to accomplish well-known results obtained for business purposes—that are to prevent others from using the same combinations or mechanical equivalents I would abolish, and thereby stop 90

per cent. of the patent business, with decided advantage to the real inventor, who at present is lost amid the multitude of imitation inventors and patent sharps.

What I propose would hardly be received kindly by the general public. The general public's heart is quite soft in regard to such things. It is generally believed that the inventor is a mechanical genius who needs protection, pursued as he is by a host of designing capitalists trying to deprive him of the fruit of his labor, his only protection being the patent laws. The individual who touches the public heart as a struggling mechanical genius, who will be crushed if not protected, does exist, but he is very rare, and one of the reasons why he has no chance is because of the multitude of pretenders. Remove the vast accumulations of so-called inventions upon which patents have been granted which have neither merit nor novelty, then there would be some chance for the public to find the real inventor and reward him in such a manner as would ease the public conscience. This might be done by either granting a patent where a real invention has been made (such a patent would have a value which under the present conditions is hardly possible) or the claims of an inventor could go before a commission composed of business men, each of high standing in his line of work, and so constructed as to cover the whole field of applied mechanics and processes of manufacture, who would administer to the inventor from the public purse a direct reward, which would be in proportion to the merit of the invention. There would, no doubt, be many objections to such a scheme because of the multitude of patents issued on what are not in any sense inventions, the holders of which reaping where they never did any sowing. All that multitude of patentees, including those whose business it is to prepare the way for inventors to obtain patents and protect them in the sole use of them, and the still greater multitude who expect to be patentees, although in no sense inventors, will have many objections to any method such as I propose, by which the real inventor might be able to bring himself into the light and receive a just reward for what he has done. It is because of this strong opposition that I have brought this subject before the Technical Society in the hope that it may be fully discussed. Some of the most prominent men in the application of the mechanical arts to our industries are beginning to look for some way whereby this huge incubus can be lifted from the free use of mechanical combinations that have been free until some clever patent expert, whose client wanted a patent, was able to so word a claim as to tie up the use of some well-known device. It may be claimed that the examiners at the Patent Office are competent to protect the public from the evils I have pointed out, but these men know nothing of what is going on in the great industrial establishments, where the real inventions, that result in progress, are being made every hour of the day with no thought of protection from patents. The Patent Office examiner is concerned only to find whether someone has not patented the same thing or combination of things before.

The real inventor has a harder time to satisfy the Patent Office expert than the combination man. The inventor must have something that is entirely new, something which the Patent Office, in all its years of collecting, has never had before, but the combination man has only to make a new arrangement of words to describe his claim. The courts also are supposed to protect the public against unjust patents, but, besides the expense involved in defending an action for infringement, there is the difficulty of procuring evidence of use. If one has to go back several years for it, it is often difficult to obtain. Drawings, made without any thought of their being required for anything except to get out the work by, are often found without date. Instructions are often given to carry out work in a certain way without any evidence being preserved of the when and why of such instructions. Those who are engaged every day in making all sorts of mechanical combinations to fulfill requirements in the specifications that describe the work under the various contracts they are endeavoring to execute have no visions of fortune through patents coming to them. They do not consider themselves inventors, and they never think of evidence in regard to their daily work. Yet these are the men who have advanced the mechanical arts to the place they occupy in the industrial world of to-day. We are all more or less interested, either directly or indirectly, in patents. My side of this question is not the popular side. I have long felt it to be the right side. I have brought it forward at this time not on any sudden impulse. It has been a growing conviction with me for the past twenty years that a change is needed in the patent laws, and that this need is growing more urgent every day.

The paper by Mr. Dickie was followed at a subsequent meeting by a much longer paper by Mr. John Richards, of San Francisco. The criticism of the Patent Office by Mr. Richards was not inimical, but he aimed to show how it is hampered by the impossibility of securing fully qualified examiners and by the gradual accumulation of precedents and rulings which must be followed. He gave a couple of instances of the curious operations and effects of present practice as follows:

Among those interested in the subject it is a matter of common knowledge that inventions pertaining to hydraulics have for many years past met with scant encouragement in the American Patent Office, and that, as an example, our waterwheel practice, a very extensive interest, is in certain types distinctly behind that of France, England, Germany and Hungary, a fact that appeared when the Niagara Commission met at London in 1890 to consider water wheels for the Niagara Falls scheme. American makers presented no plans that the commission considered, or even mentioned, in their report, except one tender from San Francisco for tangential wheels, which I had the honor to prepare.

Pressure turbine practice in this country, except as to one type, the centripedal or central-discharge one, came from France, and the best examples in use here were made under the patents of Fourneyron and Jonval, while the Girard type, that was best suited for use at Niagara and for high heads, was not until 1893 made in this country at all, and was then so badly made as to fail, so that no impulsive acting wheels of any kind were made, down to the evolution of the tangential type on this coast.

How a country where so much water power is employed under all kinds of heads and conditions could go on until a few years ago without any manufacture of the type of water wheels known as the Girard class of unfilled or partial turbines, one of the most common in Europe, will appear if we examine the history of some early inventions here.

In February, 1853, fifty years ago, Mr. Jearum Atkins, of Illinois, I think, filed in the Patent Office at Washington an application for an improvement in water wheels of the unfilled or impulse type, and in his specification set forth, in the form of a well-written treatise, the principles on which his wheels operated.

This application was promptly "rejected." No unfilled turbine had been seen before, and Mr. Atkins, being a poor man without resources, and an invalid besides, was not able to prosecute his case by appeal or otherwise, and, as the patent could not issue because of "rejection," he was unable to work his invention, except to make one very successful wheel; so the invention was strangled, so to speak, by rejection.

About 1860, seven years later, Messrs. Escher, Wyss & Co., of Zurich, Switzerland, began making water wheels of the same type, and the practice rapidly extended all over Europe, especially in France and Switzerland, and, as I have remarked, came back to this country in 1890 through the plans of the water wheels at Niagara, which were made from drawings furnished by Messrs. Faesch & Picard, of Geneva, Switzerland, who, with four or more other European firms, tendered full designs for the construction of these wheels.

In 1875 Mr. Atkin's invention was somehow resuscitated at the Patent Office in this country and a patent was issued to him, but too late to do him any good or to aid in founding the manufacture here. Mr. Atkins, when I last heard from him,

was living at an advanced age in the Mechanics' Home in Philadelphia.

He was an original inventor, perhaps the first to discover and explain what are called impulse or open-turbine wheels, in which the discharge vents are larger than the inlet ways, and was the first, in this country at least, to lay down in a clear manner the principles involved in this kind of water wheels, which include the tangential type extensively made and used on this coast.

Suppose the patent of Mr. Atkins had been issued in 1853, even with all the objections that were urged against it in the Patent Office, no one will doubt that the inventor's representations and his better understanding of the subject would, in either a business way or even in suits at law to defend his invention, have been quite sufficient to work and sustain his patent; and if this had been done, this country would have reaped a great reward from the invention.

It is not contended that the examiner should have known that a turbine water wheel would operate when not filled and when the discharge passages had double the area of the inlet ways. A recorded opinion to that effect would by no means have destroyed Atkins' patent if it had been issued at his request, but "rejection" took away his power of utilizing the invention and destroyed it, whereas it is quite sure the courts would have sustained his claims, notwithstanding the action of the Patent Office.

I could go on and show that in centrifugal pumps, gas engines and other important manufactures procedure in the Patent Office has hindered progress. Just at this time I have failed to have a distinction made between impulsive-acting and pressure fluid machines operating by steam. Both types seem to be in one class, although their manner of operating is essentially different.

It is like the old problem of 1853, or, rather, is the same problem over again, and the result is that there is not a manufacture of impulsive-acting steam engines in this country that is not either an imitation of European practice or paying tribute to foreign inventors. The first successful engines of this type, of which I have any knowledge, were made about eighty years ago by William Avery, of Syracuse, N. Y., an uncle of Prof. John E. Sweet, who made fifty or more, and, as I have just remarked, there is not at this time a separate division in which these engines could be classed in the Patent Office.

In 1895 a distinct invention in ignition apparatus for gas engines was made by Mr. Geo. E. Hoyt, of San Francisco, in which the "time function" was regulated by resistance and distance of flow of the gases into a tube, having a small bore about 1-30 inch in diameter. This invention was presented and persistently prosecuted before the Patent Office for two years. The inventor sent to the office tubes 5 inches and others 30 inches long, with affidavits to show that both had been on the same engines under the same conditions, and that it was the contracted bore, resistance and consequent velocity of flow into the tubes that determined the time point of ignition.

The claims were rejected by the primary examiner on irrelevant references, and by the examiners-in-chief, and was abandoned because the parties in interest concluded, and yet believe, that the invention was opposed on technicalities and not considered on its merits as an invention. This was the last application for letters patent filed in this country by that company. They are still prominent makers of gas engines here.

One examiner will be said to act carefully and impartially; in another division, it will be said, nothing escapes rejection, and attorneys dread to send in cases. Any experienced solicitor of patents will confirm this statement. Its significance lies in the fact that the present rules do not provide impartial administration.

There is no intention to disparage or underrate the eminent attainments of a large number of officers in the Bureau, but even these are bound by a routine of rules and precedents that prevent personal and responsible action in technical matters. They are bound to consider terms and forms of speech that are purposely made entangling and obscure, and not the essential facts.

Relation of Employer and Employee in Reference to Inventions.*

BY GRAFTON L. MC GILL.

It is an elementary principle of law that patents for inventions shall be granted to the first inventor of the improvement. The first inventor is he who first perfects the invention and renders it capable of successful operation. He alone is entitled to a patent, and although at the time of completing the invention others were in the field engaged in developing the same idea and experimenting to that end, his rights are not affected, unless it is that one who conceived ahead of him was at the time that he entered the field using reasonable diligence in adapting and perfecting the invention.

It is the policy of the law to secure to inventors every right to and protection for their inventions and afford redress for unlawful trespass by others. Patents are property. They are given as a consideration or reward for the benefit inuring to the public upon the expiration of their term. There are no restrictions imposed by the law upon an inventor's rights to a patent or protection thereunder. Indeed, there is no benefit available under the law which guarantees more liberal protection than that of our patent system. No distinctions arising from situation or business calling are recognized. No one is barred from receiving a patent for his invention, with the single exception of employees of the Patent Office, and even that restriction is waived upon the employee leaving the Office. He may then patent his invention, though it was conceived prior to or during his employment.

But these general rules must necessarily find exceptions arising from the relations which individuals assume in their business and with reference to their inventions. Labor and inventive genius may be required in the development and reduction to practical form of a basic invention. Suggestions as to the mechanical embodiment and method of operation of a principle—ancillary and subordinate to the main idea—may require the services of men skilled in the art to which it relates and competent to work out the invention into practical form. Under such circumstances the persons who in the course of their employment incidentally create useful inventions; those who are employed for the purpose of inventing and those who make subordinate suggestions to the inventor of the basic idea, assume relations which remove them from that position of equality in which it is the purpose of the law to regard them as standing. It becomes necessary to establish doctrines applicable to the nature of the relations, and in doing so, and at the same time preserving as far as possible in each individual the right to his own inventions, the courts have had no easy task, and the rules they have laid down are characterized by a desire to effect the greatest good for all concerned.

These relations naturally are of most frequent occurrence between employers and their employees. The attitude formerly assumed by employers of discouraging their employees from developing inventions, through a possible fear that such inventions might supersede the articles, machines or methods sold or employed by themselves, has, in recent years, very materially changed, and it is rather the desire now to encourage and facilitate the inventions of the employees. This is due in no small measure to the fact that the merit of the employee's invention has asserted itself in spite of obstacles, and because in the progress of the arts so essential is the work of the skilled mechanic that he is indispensable in the reduction of many important inventions to practical form. This has resulted in opening a new field of employment devoted solely to the exercise of inventive genius and mechanical skill. Instead of the invention being merely an incident to employment, it is now often the sole consideration. The employer is always ready to adopt an invention which will facilitate his work, reduce the cost of manufacture or promote the efficiency of the articles he produces. An employee, skilled in his work, soon invents means for attaining some or all of these objects.

* A paper read before the Modern Science Club of Brooklyn, N. Y.

Let us consider the relations in the order they are stated above. First, where the employee's services simply involve the exercise of skill in his calling and do not require that he invent. If he, in the course of his employment, with the tools, machinery, material, and time of his employer, creates an invention, it is apparent that although he is the inventor and has produced only what his own inventive genius has made possible, yet something has passed to him from his employer, some benefit has accrued to him for which he is in a measure obligated. The law recognizes this obligation and seeks to confer certain rights upon the employer. But these rights vary with circumstances and also with the nature of the invention. If the employee permits the invention to go into use in his employer's business and acquiesces in such use, the law presumes that he so intended, and that by permitting it an implied license was created conferring upon the employer the right to use the invention. But the nature of the invention must also be taken into consideration and likewise the employer's business, for it is obvious that if a printing press be the subject of the invention and the employer a printer, using the press in his business, a different situation exists from that where the invention relates to a process of reducing ores, and more at variance yet with the situation where the invention comprehends a product made and sold in quantities, as valves or locks, and the employer is engaged in their manufacture and sale. The general rule is that the employer is entitled to use only the specific machines made under his employment; but while this would apply to the instance given of a printing press, yet obviously it could not determine the situation involving the process. A process is intangible, indivisible, and to confer any right whatever upon the employer he must be permitted to continue its use. Where the employer has been making and selling an article in unlimited quantities and without objection from the employee, the latter will be held to have agreed to such manufacture and sale, and this presumption will grow proportionately to the time that the employee allows to elapse before asserting his rights.

It will, of course, be understood that the relation now being discussed creates on behalf of the employer merely a license or right existing only between himself and his employee and not capable of transfer by the employer against the wishes of the employee. But if the employee permits a third party, as another company, to also use the invention, and the business of his employer passes to such third party, the latter will be regarded as justified in continuing the use. But in all the instances given the relation does not affect the title to the patent or the invention which it embraces. This remains in the employee.

Considering now those who are employed to use their skill and inventive faculties in improving the machinery, appliances, or methods used by the employer. Here the employee offers his skill and ingenuity in improving devices as the value to pass to the employer in return for the salary the latter is to pay. The essence of the employment is to create a benefit to the employer's business. When this situation is present, the inventions of the employee which are within the terms of the contract belong exclusively to the employer, and likewise the title to the patent and the monopoly which it creates. But it is necessary to fully establish on behalf of the employer that the invention was within the terms of the agreement and that the latter was clear in its purport and understood by the parties. Where its meaning is vague, or the evidence tending to support it is insufficient, equity will not decree a transfer of the patent title to the employer. And herein is involved a peculiar and almost inconsistent attitude of the law in respect of this kind of employment. It recognizes the validity of a promise or agreement to assign the right to patent, though such agreement be merely oral. It is not necessary that it be in writing as in the case of the actual deed of assignment of a patent or the invention embraced by an application for patent. And yet when litigation arises requiring it to be determined exactly what was embraced by such agreement, evidence contrary to its alleged scope and provisions will create the presumption that the understanding was not mutual, that its terms were not precise, and therefore vague and indefinite, resulting in a refusal of the court to decree that the title shall be conveyed to the employer. In one case an employee made an improvement which he patented and afterwards left his employer. In the suit to determine the right to the invention directly opposing testimony was offered to show the terms of the agreement between the employer and employee. On behalf of the employer it was maintained that the employee merely asked for the money necessary to patent his improvement and said he would not want any interest in the invention. On behalf of the employee this was denied, he insisting in substance that the company offered to pay the expenses and that there was no understanding as to the title to the invention. This case was carefully considered by the Circuit Court at the trial and by the Supreme Court of the United States on appeal. The lower court said that where the testimony was so conflicting the circumstances must govern in order to reach a determination. It took the ground that not only had the employee been hired for the purpose of improving, and that in consequence his productions were what had been bargained for, but the improvement which he brought out was what might have been reasonably expected—that is, his invention was not of such a broad generic nature as to have been impossible of contemplation by the parties to the agreement, and that, therefore, the invention and title to the patent covering the same should be transferred to the employer. But the Supreme Court reversed this decision and held in substance that the lack of certainty as to the agreement was enough to deny to the employer the right to the employee's patent.

The discussion of the two relations thus far considered shows that the mere naked license on behalf of the employer may readily be established, but that his right to the complete title to the employee's invention must be supported by a clear and unequivocal agreement.

The third class of relations has reference to suggestions which one person may make tending to perfect the invention of another, reducing the basic principle to practical form. While this relation may arise wholly independently of employment, yet it generally happens that the originator of the generic idea employs skilled workmen to aid him in carrying out his invention and providing the necessary mechanical devices. This relation, while obviously created for the sole benefit of the employer, may, in the absence of a definite agreement, as above discussed, result in the entire invention being that of the employee. In order to preserve in the employer the right to the invention—that is, his broad idea, together with the suggestions—it is essential that such suggestions be ancillary, subordinate to the conceived design of the employer. If he has discovered an improved principle and employs others to assist him and they in the course of experiments make valuable discoveries ancillary to his invention, the employer is entitled to those suggestions and may embody them in his patent, claiming them as his invention; but where the suggestions are more than merely subordinate to the main idea, where they constitute the whole substance of a separate invention and embody sufficient to enable an ordinary mechanic, without the exercise of ingenuity, to make and operate the machine or carry out the process, there the employee's suggestions rise to the dignity of an independent invention. He alone is the inventor, and if the patent embodying the suggestions be issued to his employer the patent is void.

This doctrine applies also when the general relation of the parties is not that of employer and employee as that relation is generally understood. It extends with equal force to the situation presented when one person or company places in the hands of another person or company an order for the construction or manufacture of a machine or article requiring the exercise of skill and ingenuity in its fulfillment. The party to whom the order is given may hold out as one of the features of his business the fuller development of a basic idea. His ability to do so is practically part of his stock in trade, and what he produces is the value he gives for the compensation he receives. The results of his efforts, subject to the conditions above stated, belong exclusively to the inventor

of the basic idea who employed him for its reduction to practical form.

The doctrine also applies to the situation where an inventor forms a partnership with one who advances the funds necessary to protect and exploit the invention. This situation is of frequent occurrence. The partner at the financial end of the firm may devise an improvement upon the invention and may, as has often been done, seek to patent the improvement for himself; but if such improvement is ancillary to the main idea brought out by his partner, if it comprehends means of construction, or relative arrangement of parts, or treatment of elements, or proportion of ingredients, tending to promote the efficiency and utility of that main idea or broaden its scope of application, such invention is merely subordinate and cannot be regarded as belonging exclusively to the inventor. Of course, a further ground upon which no patent should issue to this partner is that he, having entered into contract relation to exploit a principal invention, is not entitled to the exclusive right to his improvement when the very spirit of such improvement is an elaboration of the invention which forms the subject of the contract.

This doctrine has sometimes been overlooked by the Patent Office when determining by interference proceedings the rights of rival claimants to a patent for the same invention. Most of the cases decided there simply present the situation of two or more inventors independently working along similar lines to attain the same end, and the main issue is priority of invention. But where it is shown that two or more of the litigants stand in an attitude analogo s to any of those just discussed, the general rule of priority must be subordinated to the unchanging canon formulated by the courts to meet the requirements of that situation.

In considering the various subjects treated herein, it may appear as if a hardship must frequently result because of the ground on which unsuccessful litigants have been held without standing in court. But it must be remembered that the policy of the law is to carry out that provision of the Constitution authorizing the grant of patents for the purpose of promoting the progress of science and useful arts. In order to do this it is necessary that the general welfare be considered and doctrines established looking solely to that end. If it be considered that the right of the employer to use his employee's invention is not reasonable, it must be remembered that there are obligations resting upon an employee flowing from his employment, and benefits resulting from the use of his employer's property. If it be thought that the contract to enter employment for the purpose of inventing, whereby the employee's inventions become absolutely the property of the employer, is a contract in restraint of trade, and therefore unlawful, it must be borne in mind that the underlying purpose of regarding as invalid contracts in restraint of trade is the protection of the general public. It cannot be extended to preclude individuals from contracting so as to bind themselves under stipulated arrangements, for that very "general public" which so jealously guards against encroachments upon its rights, maintains as one of its foremost principles the liberty of each individual to contract with respect to his own affairs. In many of the cases where a possibly meritorious inventor has been deprived of his rights his loss has been solely due to his delay in seeking redress for their trespass. The equity courts are responsive to appeals promptly made upon injury being sustained, but where time elapses and one sleeps upon his rights his standing grows weaker with the lapse of time. Tardy complainants often delay because to bring their action they must abandon a position more lucrative than the possible results of an adjudication in their favor. Equity often goes behind the facts relied upon to ascertain the presence of this situation, and it has generally found it, or an equivalent ground, before denying to a complainant that relief to which he appears entitled.

A serious fire occurred January 22 at the works of the E. W. Bliss Company, Brooklyn. The main building of the works occupies an entire city block and the fire, which originated in the upper stories at one end, was finally subdued. One fireman was killed by falling from a ladder and being impaled upon a hook. It is stated that the loss is fully covered by insurance and that no delay will be caused on contracts.

Someone has started a story in the "news" papers that some of the match companies are cutting the wood for matches "on the bias" so that the matches will break off when struck and more matches will be bought. This seems absurd, because people would soon learn to buy matches of other makes, and in fact such "trade tricks" as the above are exceedingly rare and almost invariably unsuccessful.

A recent patent provides for the maintenance of a vacuum within the rim of a flywheel to prevent its bursting, which is more sensible—just a little—than it would be to get a vacuum on the outside of the rim to prevent its collapsing.

Nearly the whole of the issue of *Engineering* of January 15 is devoted to the Chilian battleship "Libertad," which was built for the Chilian Government by Messrs. Vickers Sons & Maxim. The vessel is very fully described and illustrated, and helps one to realize the fact that a modern battleship probably comes nearer embodying the full expression of modern engineering science and skill than any other single structure.

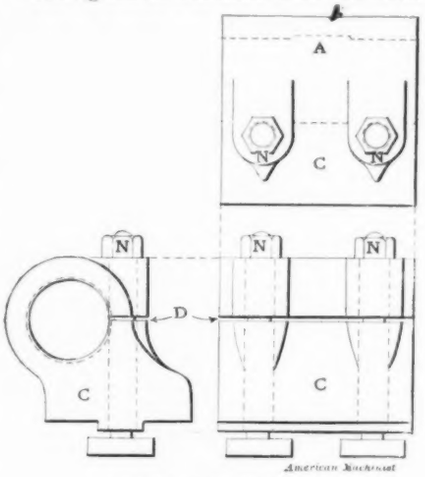
Letters From Practical Men.

Another Boring Bar Holder.

Editor American Machinist:

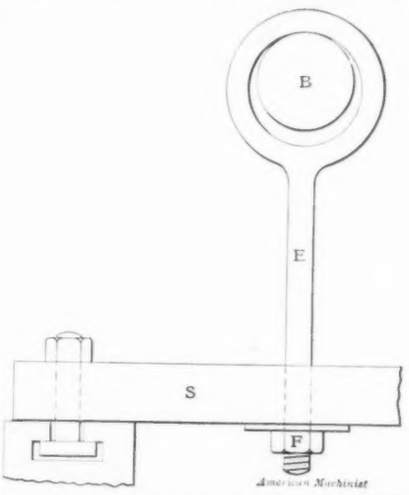
Mr. Osborne's article, at page 16, about "A General Utility Boring Bar Holder," interested me very much, I having been in the same boat; that is, having some long holes to bore and no tools at hand that would do the job satisfactorily.

The rig shown was made to do this work



A BORING-BAR HOLDER.

and proved to be very satisfactory. I do not send this to criticise Mr. Osborne's device, but to show how different people having practically the same thing to do, devise ways to do it in some cases not at all alike and at other times very much alike. In this case, the bar and bushings



HOLDING THE REAR END OF THE BORING BAR.

were exactly the same as Mr. Osborne's and on that account are not shown.

The bars were made double enders, however; one end with the tool set straight and the other end with the tool set at an angle of 45 degrees, the point of the tool coming out of the corner of the bar, to use for facing, for boring to the bottom of a hole, and also handy when wanting to use a larger bar than could be used with the straight set tool. With the tool set at an angle it cuts its way ahead of

the bar and often allows a bar of ⅛ or ¼ inch larger diameter to be used than could be possible with a straight set tool.

The casting *C* takes the place of the regular tool-post, and is clamped to the cross-slide, the tongue fitting the slot, and at the same time it clamps the bar by the tightening of the nuts *N*. The hole for the bar was bored out slightly larger at the center, as shown at *A*, to prevent any rocking. The clamping bolts have large square heads to fit the slot in the cross-slide and to prevent them from turning.

The back end of the bar is held, as shown in Fig. 2, by the strap *S*, bolted to the ways of the carriage, and by the eye-bolt *E*. A thumb-nut could be substituted in this place, as in practice it was found that a wrench was never required to adjust it. In making this rig the casting *C* was clamped in position on the cross-slide and the hole for the bar was bored with a boring bar held between the centers, the slot *D* being cut afterwards.

M. H. Ball.

Handling Things on the Crane.

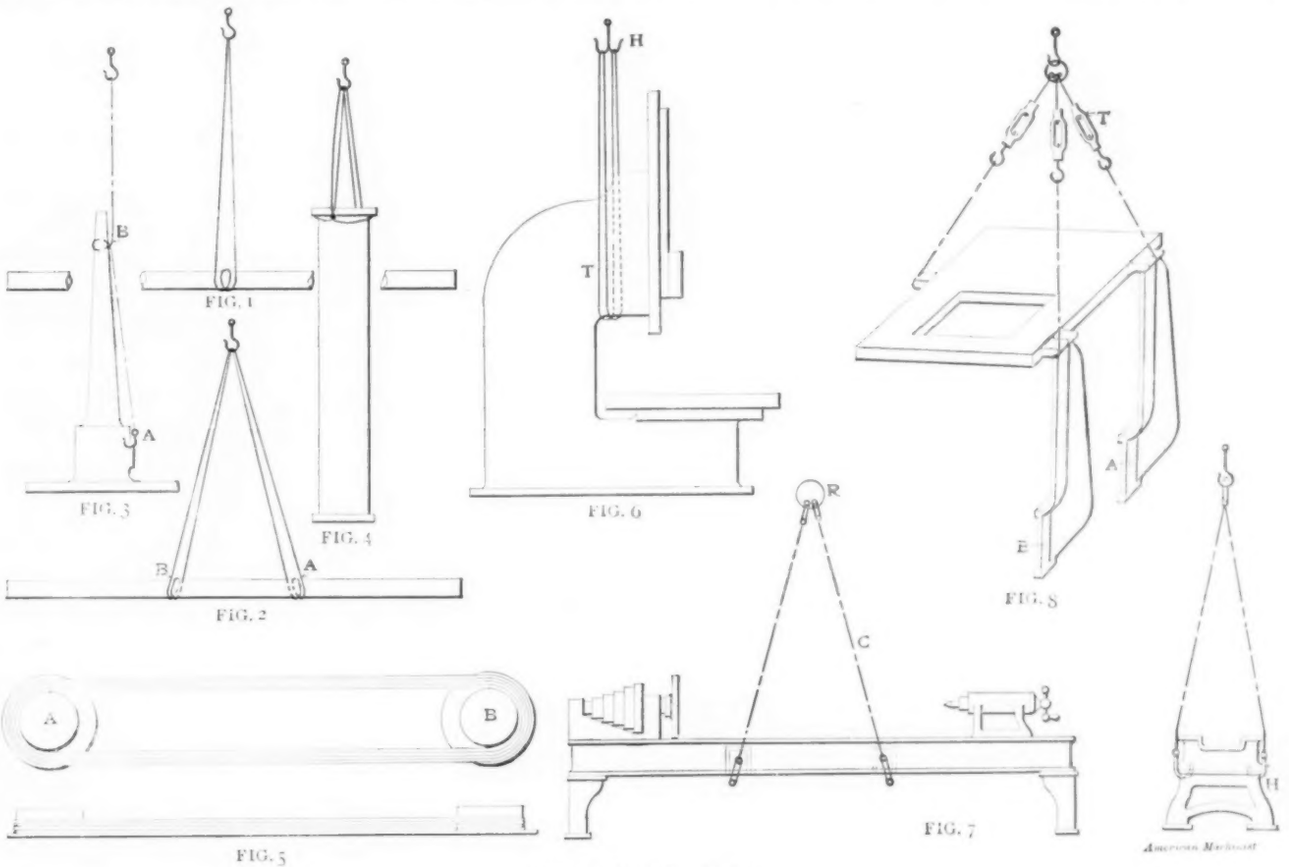
Editor American Machinist:

There are many ways of handling things on the crane; some are good and commendable, and others are costly and dangerous. It is not an uncommon thing to find the rigger in a shop applying a rope to a long bar of iron, as in Fig. 1. He guesses about where the center of gravity would come, and however closely he may guess the bar will always swing out of level when the crane hook is raised, and thus he is obliged to lower the crane hook, shift things one way or the other to suit and then make another attempt. He finds that it will still cant one way or another, and he is thus obliged to spend a lot of time, and probably has to balance the thing by hand as it is carried through the shop. A much more satisfactory way of handling this piece of work is shown in Fig. 2. An endless rope is taken and wrapped once around the bar, as shown; the two ends are then thrown over the crane hook. By pulling the rope apart at *A* and *B* so as to form a triangle, and by making a guess at the center of gravity and placing the crane hook over it, we are able to lift this work at the first attempt. In this way we may hitch our crane considerably out of the center of gravity and yet be able to carry our work nearly level with perfect safety.

In Fig. 3 is shown a column for a radial drill. It is a very difficult thing to rig up this column after the manner shown in Fig. 1. A hook on the end of the chain is entered into a cored hole at *A*; it is then carried nearly to the top of the column and then given a turn, and from thence it leads to the crane hook. This arrangement cannot slip, and the piece will be carried through the shop in almost a vertical position. Fig. 4 shows a heavy cast-iron pipe, which it is intended to raise up in the air and lower in position over a piston. This should be raised in a vertical position, in order to lower down over the work nicely. Very serious accidents have happened in connection with just this kind of a job. The safest way to handle it is to make what is known as a basket hitch, either with a chain or rope, as shown in Fig. 4.

Endless chains and rope slings are used to good advantage about the shop, but when we are handling extra heavy machinery we frequently run beyond the capacity of the rope. A very good arrangement for handling such work can be made after the manner shown in Fig. 5. *A* and *B* are two wheels arranged with flanges as shown. Around these wheels tarred rope is wound, one turn after another, all of the same tension, until sufficient is obtained to give the size and strength required. It is then bound together with tar rope, so as to form one solid cable, and is then covered with canvas. This is very useful for handling a finished machine, as shown in Fig. 6. One can raise a heavy weight with this kind of sling without fear of scratching. The sling is put around the throat *T* of the machine and the ends are thrown over a double crane hook at *H*.

Where we manufacture a great many machines of the same kind it is a good thing to make special arrangement for connecting up things to the crane. Thus in Fig. 7 we have a ring *R*, to which four chains *C* are attached. These chains have special hooks *H* at the lower ends, and these engage in pockets underneath the bed. To



WAYS OF SLINGING WORK.

keep these chains from abrading the finished faces, they are covered with leather.

In connection with this matter of using chains, it may be well to mention that many accidents have occurred through the failure of links, and others by the opening up of various hooks. Chains should be annealed once or twice a year, depending upon the rough usage to which they are subjected. Steel castings should be avoided in hooks as much as possible where chains are thrown over the hook, for the reason that every time a chain is applied to such a hook and the weight is taken up, the links of the chain will press dents into the hook.

The traveling crane in a shop is usually kept so busy that we do not have time to hold pieces in position for an hour or so in order that measurements, etc., may be taken; for this reason we are frequently obliged to resort to a jib crane. Many pieces of work are held in position on the erecting floor by a jib crane in order to line up, etc. Thus in Fig. 8 we have a motor bracket together with the supports for it, all bolted up ready to be applied to the machine. It is a difficult thing to level this up by the ordinary means, and much time can be saved by having three turnbuckles fixed up in a chain, as shown. These can be attached to the bracket to be hoisted, as shown, and the whole thing can then be drawn up in place and leveled by means of these turn-buckles. One other thing might be mentioned in regard to work of this sort: Trial holes of large diameter can be drilled into the pieces at *A* and *B*. The bracket is then held up in position and the holes *A* and *B* are scribed off on the machine. The holes are then drilled and tapped and the brackets are screwed into place with a tap bolt. The large hole will admit of shifting the bracket to the exact position. The other holes can then be scribed off and drilled and the whole thing bolted up permanently into place.

FRANK B. KLEINHANS.

Milling Machine and Bench-Lathe Chucks.

Editor American Machinist:

At page 652, Vol. 26, is shown a bench-lathe chuck, and I take the liberty of suggesting some improvements. The lathe chuck there shown necessitates the construction of a new spindle and the insertion of bulky parts, besides the waste of time in attaching, adjusting and detaching.

Fig. 1 shows a device for holding threaded work in a Brown & Sharpe dividing head. It consists of a collet *a* of machine steel, case-hardened, the hole being lapped out straight, and the outside then ground on an arbor. The nut arbor *c* is made of tool steel, hardened and lapped to a sliding fit in the collet *a*, the thread being lapped to fit the work. One or two threads at the end are ground off to the root to form a pilot, so that work can be screwed on with little loss of time. The rear end is threaded to receive the rod *f* which has an elongated slot near its other end for the cam *g* to work in. A washer *i* is bored for the rod *f* and provided with a bushing *b* which has a turning fit in the rear of the spindle, thus holding the rod central. On the other side of the washer a slot is milled to receive the flat piece of steel *j*, which passes through the slot in *f* and forms a bearing surface for cam *g*. Plate *j* is secured to washer *i* by two screws, not shown. The manipulation of this device will be readily understood. After screwing the work on

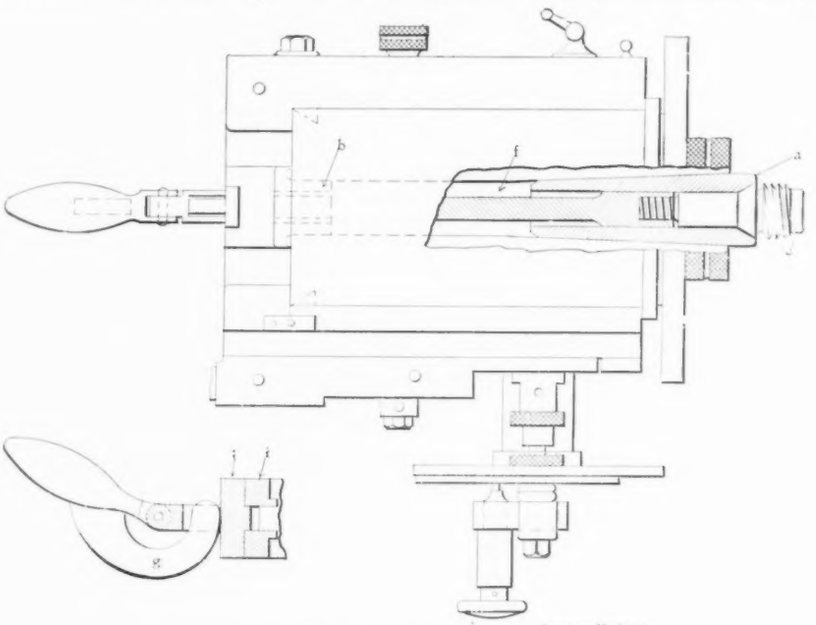


FIG. 1. MECHANISM FOR HOLDING THREADED WORK.

c the cam lever is pressed down, drawing rod *f* and arbor *c* back, and bringing the work against *a*, where it is held securely. When cam *g* is released, the work can be removed readily and without knocking it to loosen it from the arbor.

Fig. 2 shows an improvement on Mr. Stabel's expansion chuck above referred to, by which it can be expanded about ⅛ inch in diameter. When chucking one piece having a larger hole than the other, it will be located accurately on the chuck, and consequently there will be no end movement as in a split bushing. This is done by simply milling five grooves at an angle of 10 degrees in the straight portion at the front end *a*, with an angle of 15 degrees on the sides. It is advisable to grind the part which goes into the collet, holding it by the thread at the front end, this being screwed into a ring that has been shoved into position. Care must be taken to do this in order to bring the body proper true with the thread. The jaws *b* are made of tool steel, case-hardened and lapped straight to a sliding fit, and its shoulder is a running fit in recess formed between the collar *c* and the ring *d*, which parts are made of machine steel, case-hardened, lapped straight and knurled, and then screwed firmly together. After it has been assembled in perfect condition, it should be placed in a bench lathe, and the top of the jaws ground, having screwed it down to its lowest diameter, so when it is screwed up to a larger diameter it will bear on the centers of the jaws; the corners should then be rounded off with an oil-stone to prevent them from dents, and from cutting the work. As chucks of this kind are expensive if used for only one size, the need of an adjustable device is apparent; the greater the variation the instrument is capable of, the more serviceable it will be. By increasing the angle of the taper or increasing its length, any desired variation may be attained.

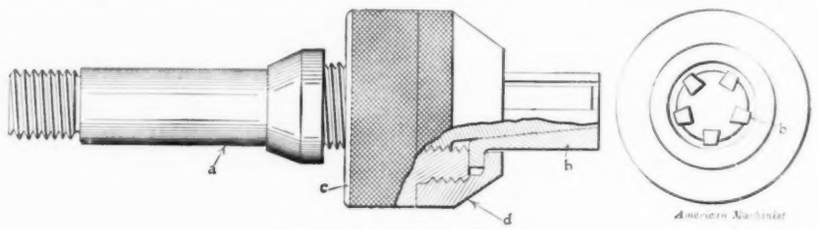


FIG. 2. EXPANSION CHUCK.

Fig. 3 shows a Brown & Sharpe dividing head holding a draw-in chuck. The arrangement consists of a collet, a bushing, a rod, and a ring. The collet *a* is made of mild steel to fit the head of the spindle like an ordinary center. At the rear end is placed a bushing *b* with a turning fit in the hole of the spindle, and a shoulder on this bears against the round tail end of the spindle, as shown in the sectional view.

The rod *c* has a 5/8-inch hole through its entire length, and has a turning fit in the hole of the collet *a* and the bushing *b*. The forward end is threaded to receive all sizes of bench lathe chucks. The other end is fitted with a round handle as on any ordinary bench lathe, with a ring *d* driven on to the rod between the handle and bushing

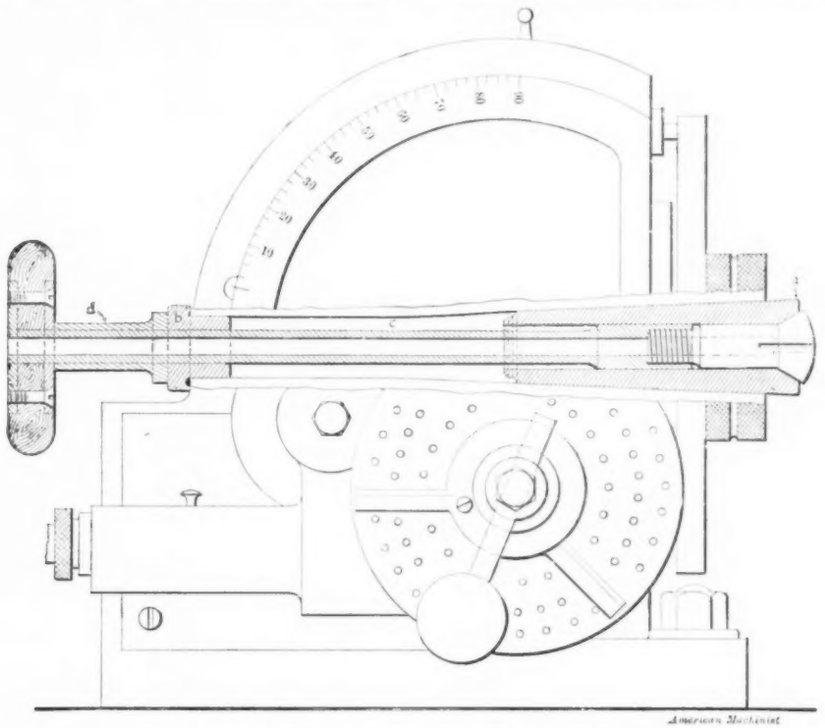
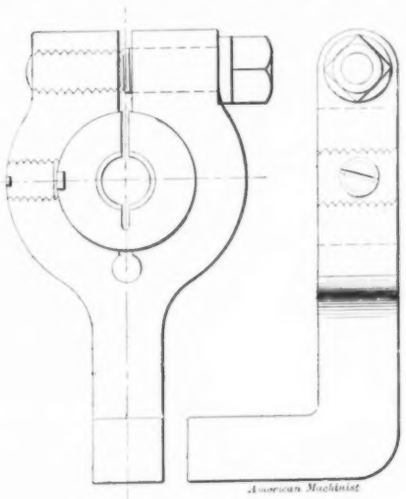


FIG. 3. DRAW-IN CHUCK FOR DIVIDING HEAD.

b to serve as a washer. This device is invaluable for finishing small taps, reamers, etc., and other work right from the bar. No cutting off and centering of work is required, as with the old chuck whose jaws are bound to run out of true more



DRIVER FOR THREADED WORK.

or less, and most of the time are in the way, so that the cutter cannot travel the required length. Since this chuck removes these difficulties, it is believed that a trial of it will be sufficient to insure its use in such operations. A slight variation of this design will accommodate it to any style of chuck which a machinist may be using.

A. L. MONRAD.

A Driver for Threaded Work.

Editor American Machinist:

Seeing the driver for threaded work by E. A. Banning, at page 1700, Vol. 26, reminded me of one that I designed a short time ago for the same purpose and which I believe is better and much cheaper, taking the number of sizes it will accommodate into consideration. Mr. Banning says that he made a carrier for each of the different sizes from 3/8 to 7/8 inch, inclusive, and put a set in each of the toolrooms of the works. Having a separate carrier for each size appears to me to be unnecessary. Instead of one for each size, I should make screwed bushes for the different sizes from 3/8 to 7/8 inch, inclusive, all to fit one carrier. Advancing by sixteenths this would mean nine carriers by Mr. Banning's method. With my way all that is required is one carrier and nine bushes. In the accompanying sketch the screw at the side is to keep the bushes in position. Each bush should be stamped with its size.

CHERRY RED.

Points for Patternmakers.

PROTRACTOR FOR SETTING BEVELS—SMALL GOUGES—A DRIP-PAN PATTERN—THIN TEMPLETS.

Editor American Machinist:

I once saw in a patternmaker's kit a good home-made protractor to use in setting an ordinary bevel. It consisted of a thin casting, lightly ribbed inside for strength, and having the top surface and rabbeted place *B* planed. The divisions were carefully scratched for every degree on the outer edge, while the pin *A* turned freely, and was kept from dropping out by a small pin underneath. The top of *A* was considerably larger than the hole drilled in the casting, and just one-half was filed away. A common bevel could be instantly set to any desired angle by placing the stock against the rabbeted edge *B*, and the blade against the flat edge of pin *A*. In whatever position the blade might be, the edge of the pin would always be radial with the graduated arc.

Sometimes a patternmaker desiring a very small inside ground gouge takes a piece of steel rod and files the inside a little, and has it tempered and fitted with a handle as at *A*, Fig. 2, but this is rather stubbed and after a short time hard to sharpen. Fig. 2, at *B*, shows a piece of drill rod the size required for the cutting edge of the gouge, with a hole drilled in the end for an inch or more, and then one-half of the rod where the hole comes is filed away. This leaves a thin edge that can be ground for a long time without difficulty.

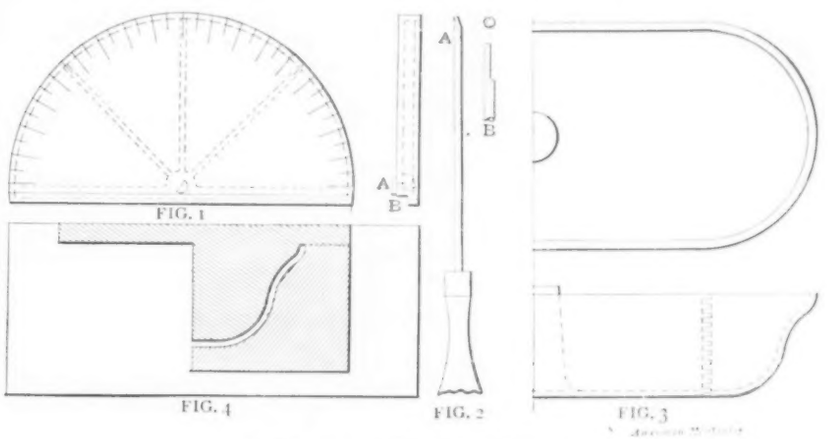


FIG. 1 FIG. 4 FIG. 2 FIG. 3

TOOLS IN A PATTERNMAKER'S KIT.

Fig. 3 shows one-half of a large drip-cup pattern. These patterns are usually made by turning a thin bowl-shaped piece for the ends, then sawing it in two, and making a butt joint with the intervening piece, next letting in small pieces across

the joints to tie them securely. Not long since I made one of these, using the kind of lock joint that has already been described in these columns, page 178, Vol. 24, and for strength I think it can hardly be equalled. The piece between the ends was sawed to match into the turned halves while still a solid block; then the outline was marked with all three fitted together. It was then removed and bandsawed to shape.

In making templets for any thin turning, of which this job will serve as an example, where it is necessary to have two, one for outside and another for inside, instead of laying out each separately, make the entire necessary layout at once on a thin piece, as shown in section at Fig. 4, and separate them with the point of a sharp knife. Then cut away the part representing the thickness of the piece turned, and the outline around what is shown in section.

For thin templets to use in fitting surfaces, either at the lathe or at the bench, I have learned that a stick of rouge rubbed on the edge of the templet is much more lasting than chalk. It seems to charge the pores of the templet, and leaves its mark on the work it comes in contact with a greater number of times, without a fresh application of color.

JOHN M. RICHARDSON.

A Test Indicator and Holder.

Editor American Machinist:

The accompanying drawings illustrate a test indicator which I have found to be very useful. Fig. 1 shows the body of the instrument with the cover removed. The tool carries, as shown, a pointer *A* which is of tool steel, hardened, ground and lapped to fit sleeve *B* and bushing *C*, rod *A* being shouldered near *D* to prevent it falling out of the sleeve. Member *A* is of course the "feeler" to be brought in contact with the work to be tested or trued up. The sleeve *B* is bored to clear *A* except at the point indicated at *D*, and after being hardened is lapped out to fit the reduced end of the "feeler". *C* is a hardened bushing which supports the inner end of *A*; it is beveled internally to leave only about 1-32 inch bearing and is forced in the tap hole in *E* by screwing sleeve *B* down on top of it The pin *A* after passing through *B* and *C* passes through a clearance hole in *E*, where it engages with the forked lever *F* which works on a pivot carried between an adjusting screw in the body and a conical seat at *G* in the cover (Fig. 2). A silk thread fastened to one of the arms at the forked end of the lever (the other arm being merely a stop for the lever) passes several times around drum *H*, thence through a hole in the lower end of the latter which is countersunk at one side so a knot to fasten the thread may be drawn into it.

At *I* is shown a hair spring which is driven on the drum shaft, and held at *J* in a drilled hole in the body of the tool by a small knurled plug forced into the hole. The hair spring keeps an even tension on the thread by pulling on the drum from the opposite direction. On the upper end of the drum shaft is a watch hand *K* which is revolved by any movement of pin *A* and lever *F*.

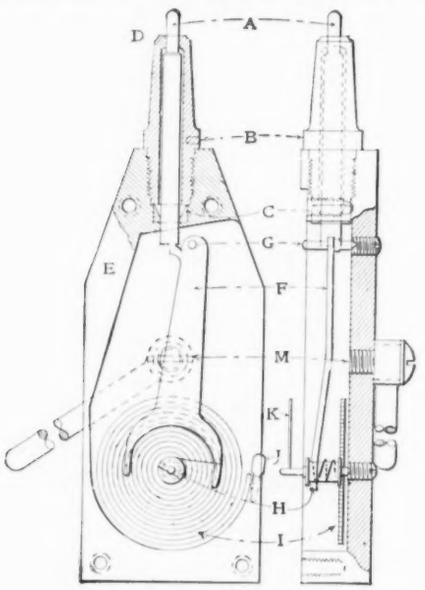


FIG. 1

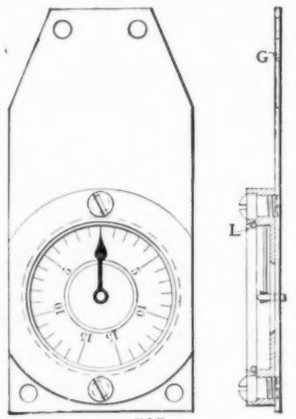


FIG. 2

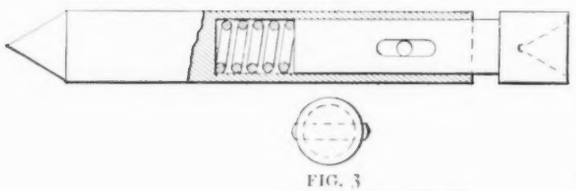


FIG. 3

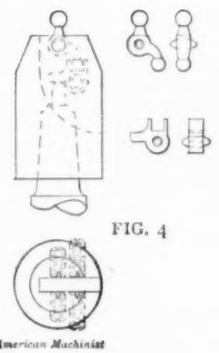


FIG. 4

TEST INDICATOR.

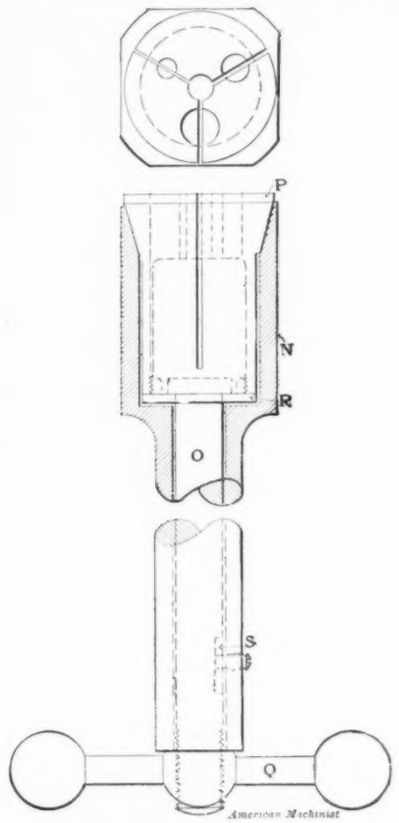


FIG. 5. INDICATOR HOLDER.

Fig. 2 shows the cover and dial with the watch hand at zero on the dial. The cover is a piece of sheet steel fastened to the indicator body with small machine screws and having a hole through it to act as the upper bearing for the drum shaft. The dial has a beveled edge as represented and is fastened in place by means of a ring and two small screws. A piece of photographic film with the emulsion washed off is cut out and laid on the shoulder just above the pointer and held in place by a round spring of piano wire in the beveled seat *L*, thus effectually keeping the dial free from dust.

In graduating the dial I fastened the disk in place on the cover of the indicator, then placed the indicator in a tool-holder and held it in the lathe tool-post and brought the end of *A* in contact with the face-plate of the lathe, first, however, scribing a zero line on the dial. Then I forced the pointer against the face-plate till the indicating hand was at zero. Next I slipped a piece of sheet metal .015 inch thick under *A* and scribed a line where

the hand showed the .015-inch line should be. Then with the sheet metal still under the pointer I brought the hand back to zero, and when I removed the sheet metal the hand indicated .015 inch the other side, the total range established thus being .030 inch. I then proceeded to divide the distances each side of zero into fifteen equal spaces, placed the dial in the lathe, trued it up, and, with a V-pointed tool set on the exact center of the lathe, by the movement of the cross-feed I cut the graduations at the points previously spaced off, very easily, and, as subsequent tests proved, fairly accurately.

In Fig. 1, at *M*, is shown a handle which is fastened to the indicator body by a screw which, when tightened against its shoulder, binds the handle sufficiently to allow the indicator to be turned about in any position desired and yet prevents it from being moved by an accidental jar. This indicator will be found to be almost entirely free from the vibration of the needle so common to indicators which are composed of two or more levers, as the vibration seems to be stopped by the hair spring, and when in use the watch hand moves around the dial with a smoothness I have not yet found in lever indicators. To those who may object to the use of the silk thread I would recommend a gear segment and pinion of very fine pitch in place of the lever fork and the thread; but after experimenting with segment and pinion I will say that the other arrangement has given me the best results—being more sensitive and less liable to become gummed up with oil and dust—and is, apparently, just as accurate. The indicator as drawn shows any movement of pointer *A* multiplied about 96 times on the dial, which result can be changed very easily by increasing or diminishing the size of the dial and the length of the hand. This tool may be used not only for testing and truing up work in the lathe, shaper or planer, but also for milling machine and surface plate work.

Now for some little appliances to be used in connection with the indicator. Fig. 3 shows a pointed instrument for use in setting center punched work true in the lathe. This device is, of course, too familiar to require any special description. Fig. 4 illustrates an attachment for indicating internal surfaces, and which will also be understood without explanation, as it is shown in place on the indicator nose and the working parts are all shown in detail. In Fig. 5 is represented a holder which is very handy for mounting the indicator in the lathe and also makes a good holder for small boring and inside threading tools. It consists of a tool-steel body *N* which is bored from end to end to allow the rod *O* to pass through it, and chambered out and beveled at the front end to receive the split collet *P* which is drawn into *N* by rod *O*, the latter being threaded at the back end to fit handle *Q*, and having at its front end a head which draws back against a threaded disk *R* which is screwed tight into the body. Rod *O* is grooved at *S* and the end of a small screw entering this groove prevents the rod and chuck from turning when the handle *Q* is tightened. It will be noticed that this arrangement allows the collet to be turned around in its seat to raise or lower the tool you may be using. This collet is the same as the ordinary one for the lathe except that it has three more holes in it—one in each slot—one of which should be made to fit the indicator handle and the others to receive small boring or inside thread tools made of drill rod or Stubs' steel. A set of plugs should be fitted nicely to the holes in the collet and each of the outside holes not carrying a tool should be plugged before the collet is tightened. One advantage of this holder is that the outside holes in the collet have a vertical adjustment of ½ inch merely by turning the collet around in its holder.

I. N. DICATOR.

Machining a Gas Engine Piston.

Editor American Machinist:

In machining a gas-engine piston, the requirements are: a true, straight surface, ring grooves smooth and accurate in width and a hole for the piston pin exactly perpendicular to the axis and at a determined distance from the closed end to insure correct compression.

The pistons are first centered upon the closed end and the bell end is chamfered out to an angle of 60 degress, for location upon the driver shown in Fig. 1. The face-plate of a lathe is recessed to receive the driver, and it is secured by cap-screws. The rectangular projecting plug engages the piston-pin bosses on the inside and affords an effective drive. After turning to the required diameter a gang grooving tool, shown in Fig. 2, is used. This has a complement of roughing cutters on one side slightly narrower than the finished groove, and by loosening the binding nut it may be reversed on the tool-block and the finishing cutters, the full width of the grooves, presented to the work.

After the lathe operations are completed, the jig Fig. 3 is employed for cross-boring and facing the piston-pin bosses. The binding screw *A* has a collar upon it half of which is recessed in the clamping ear and half in the hardened plate *B* which is attached to it, thus acting to clamp the jig upon the piston, and when changing the work to force the fixture open against the spring of the heavy rib at the back. The locating stop *C* serves to bring the compression uniform, and the forked gage, Fig. 4, is applied with its tongue in the slot *D* to determine the perpendicular location of the bosses.

A twist drill ⅛ inch small, a three-groove chucking reamer .008 inch small,

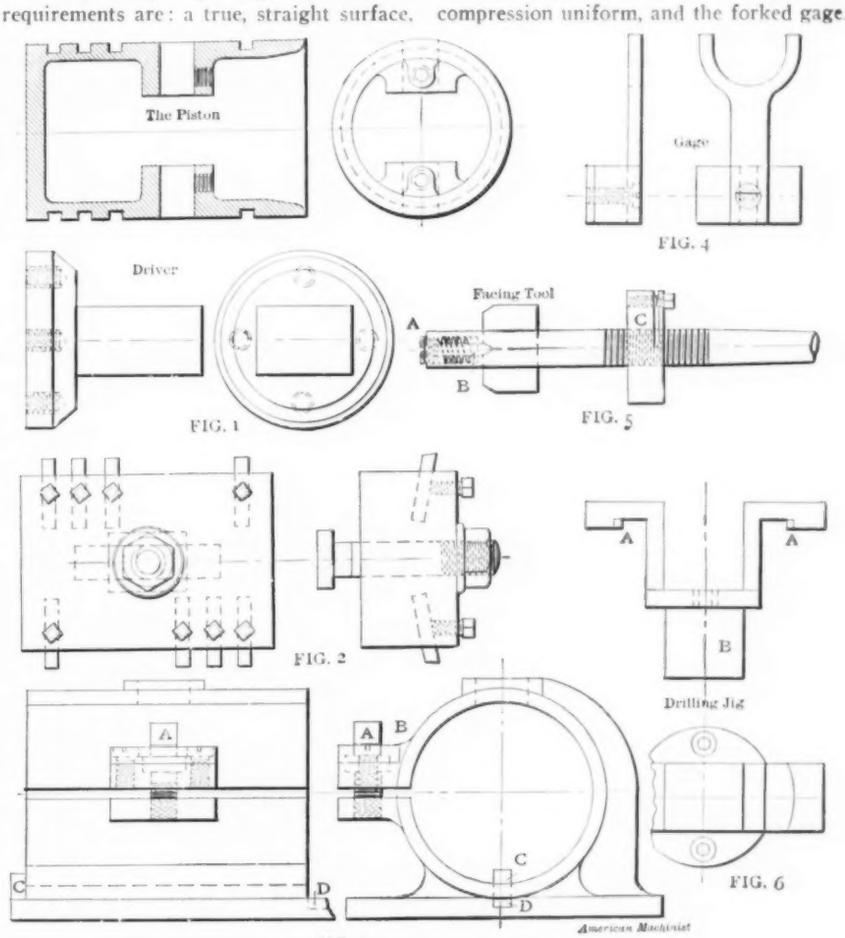


FIG. 1 FIG. 4 FIG. 5 FIG. 2 FIG. 6 FIG. 3

TOOLS FOR MACHINING A GAS ENGINE PISTON.

and a final finishing reamer, size and straighten the hole, after which the bushings are removed and the facing tool shown in Fig. 5 is employed to face the bosses central, and to a specified distance apart. The shank of the tool is bored out below the cutter and threaded to fit the retaining plug *A* against which a spring acts to force the center on the end of the shouldered pin *B* into engagement with the 60-degree notch in the center of the cutter, this centering the latter. The corners of the cutter are beveled to pass the pin easily. In operation, the cutter being removed, the bar is lowered through the hole, the cutter inserted and the boss faced until the adjustable stop *C* strikes the top of the jig, when the piston is reversed and the operation is repeated on the opposite side.

The drilling jig, Fig. 6, locates upon the periphery of the piston at *A A* where the flange is recessed to receive it. The square plug *B* is a fit between the piston-pin bosses and is a further means of location. This makes a quick acting and efficient tool for drilling the set-screw holes in the piston-pin bosses after facing.

The general practice has been to make the pistons a fairly tight fit in the cylinders, some makers even driving them in and operating them by the assistance of other than their own power for a short time, after which they are removed and the high spots relieved. In this case a rougher finish was considered desirable on the work, to more easily produce a bearing through wear; but the smooth reaming of the cylinder and the high finish of the piston, with free running initial fits, are rapidly growing in favor among the more progressive makers.

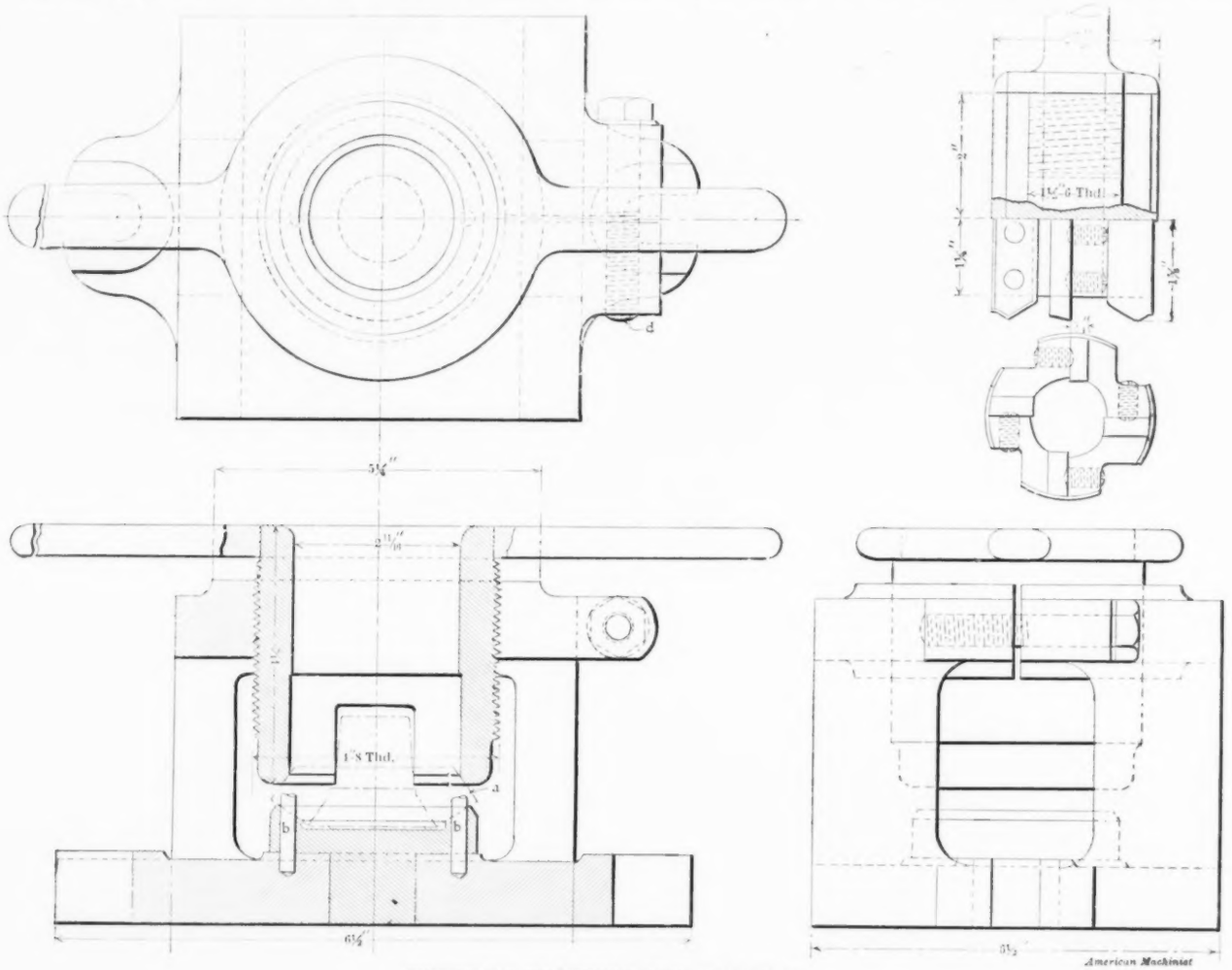
LUCIEN I. YEOMANS.
CHAS. E. SIGLE.

A Drill Press Fixture for Machining Bevel Gear Hubs.

Editor American Machinist:

The accompanying blueprint shows a fixture which allowed us to handle in the drill press a job that was being done on a turret lathe, it being necessary to relieve the overcrowded condition of the latter tool and at the same time increase the speed of the operation, which this fixture did in the most satisfactory manner. The piece of work was a drop-forged bevel gear, with a hub that had to be turned to size and a rear face to be formed, both of the cuts being made with the hollow mill shown whose inserted blades were formed at their forward ends to give the gear back its required form. The fixture was very simple in design, it being composed of a cast-iron frame which was held securely to the drill-press platen with two bolts. The gear *a* rested in a seat formed in a piece of tool steel, which, after its lower part was turned to a press fit in the casting, was hardened. Also in this piece were two dowels *b b* which helped to prevent the gear from turning in the fixture. The top part of the fixture was bored and threaded to receive the threaded and hardened tool-steel bushing *c* which held the gear in position, and acted as a guide for the hollow mill; the body of this tool was of machine steel, case-hardened and then ground to a perfect fit in the bushing, the shank being made taper to suit the spindle of the press. To compensate for wear in the thread, of cast iron, a slot was milled through to the bore and an adjusting bolt *d* fitted in the lugs, as shown. The handle for manipulating the screw bushing was a shrink fit on the end of the latter. The machine did not have to be stopped when changing work in this fixture; and though we were enabled to use a less expensive machine than formerly we also got better results.

JOS. M. STABEL.



FIXTURE FOR MACHINING BEVEL GEAR HUBS.

Taper Holes in Machine Spindles.

Editor American Machinist:

To produce a taper hole in the nose of a lathe spindle with the highest degree of accuracy and truth possible with the least chance for a mistake to occur through carelessness of workmen, has been one of the problems successfully solved by the shop management of the Lodge & Shipley Machine Tool Company.

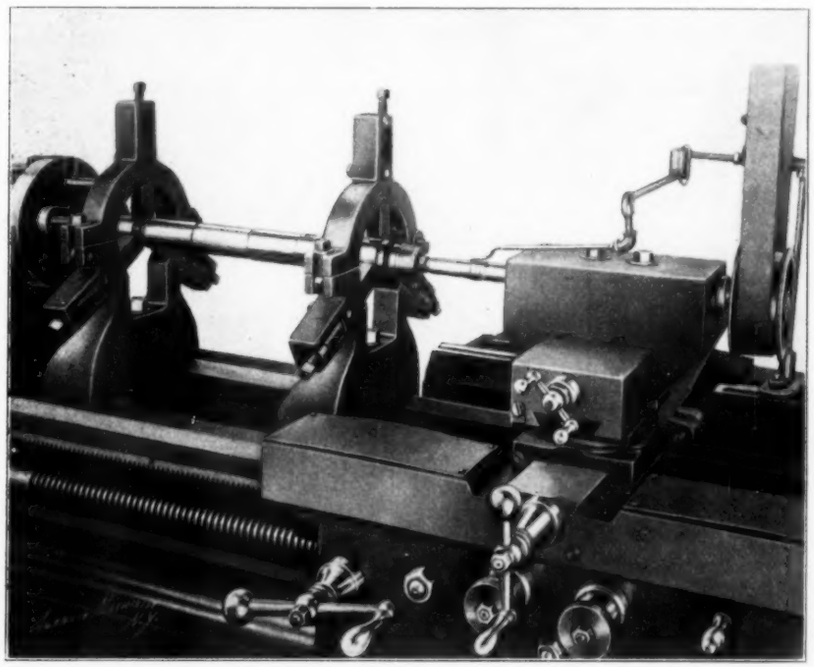


FIG. 1. TAPER HOLE MILLING ATTACHMENT.

The method now used produces a true taper hole in all spindles without the cutting and trying usually found necessary. The stock, as cut from the bar, is first rough turned to within 1-16 or ⅛ inch of the finished size in a high-speed rapid reduction lathe, where cuts of 1-inch reduction and ⅛ inch feed at 125 feet cutting speed are possible. The hole is then drilled in a special spindle drilling lathe, on which a record of a 1 5-16 inch hole drilled at the rate of 2 7-16 inches per minute has been made, using a special drill with a high-speed steel point designed for the purpose by the shop superintendent. The taper hole is here rough bored to approximate taper and size, using a three-lip reamer of special design. The spindles are then turned to within 1-100 inch of finished size, on large centers, and thereafter ground to a final finish. With the spindle mounted in two steady-rests and running upon the finished bearings, the taper hole is milled to the desired taper and size by the lathe attachment shown in Fig. 1. The milling cutter is run at a high rate of speed against the rotation of the spindle and cooled by a constant flow of cold water. The required angle is secured by the taper attachment mounted on the back of the carriage with the swivel doweled to secure the standard taper. The spindles leave this lathe as cool as when first mounted, and with the taper hole so near standard that the grinding device shown in Fig. 2 produces in a few moments a finished true hole, in which the test bar discloses no imperfections to be corrected by the cut-and-try method. During this grinding operation the spindle runs, as shown, on its own finished bearings and under the same conditions as when in the headstock, where it will eventually run. To insure accuracy in standard tapers, test plugs hardened and ground are used for testing the diameter and angle of taper. A very long test bar is also inserted before removing from the grinder, to check the truth and accuracy of the hole. Running the emery wheel through the hole a time or two corrects any inaccuracy that may be found to exist at this stage. The centers for all spindles are carefully ground and pointed in a special grinder, are perfectly interchangeable between all lathes of the same size and can be inserted in any position and run true.

C. F. PEASE.

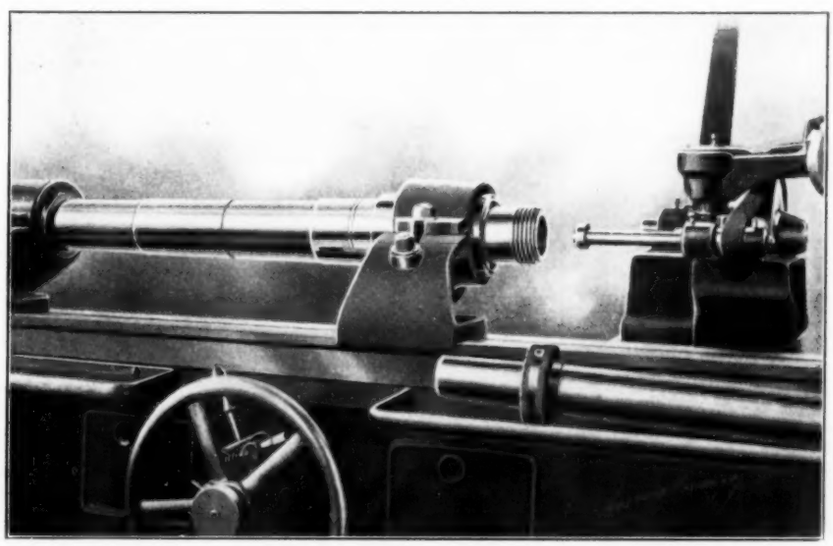


FIG. 2. TAPER HOLE GRINDING RIG.

Binding Periodicals.

Editor American Machinist:

We can of course have our periodicals bound by a regular bookbinder, but there may be those who, like myself, cannot spare the money and therefore resort to some other method. I use the following scheme. Take the AMERICAN MACHINIST, for example, which I bind in volumes of six months each. Remove the advertising pages to reduce the bulk, and after arranging according to date they are ready to bind. Select two cover pages. Take one and lay off ⅛-inch holes ½ inch from the edge and spaced about 1 inch centers. Use this for a templet to punch the remaining covers and papers about two or three at a time. After punching, place the covers on and lace all the articles together with a strong cord drawn as tight as possible by hand and tied, and the volume is in shape for filing. The sketch shows the job

BINDING PERIODICALS.

finished. Covering the bound edge with cloth adds to the life and the looks of the volume. I use a card index on all the articles pertaining to my line of work, and when reference is to be made it is with all the convenience of any bound volume.

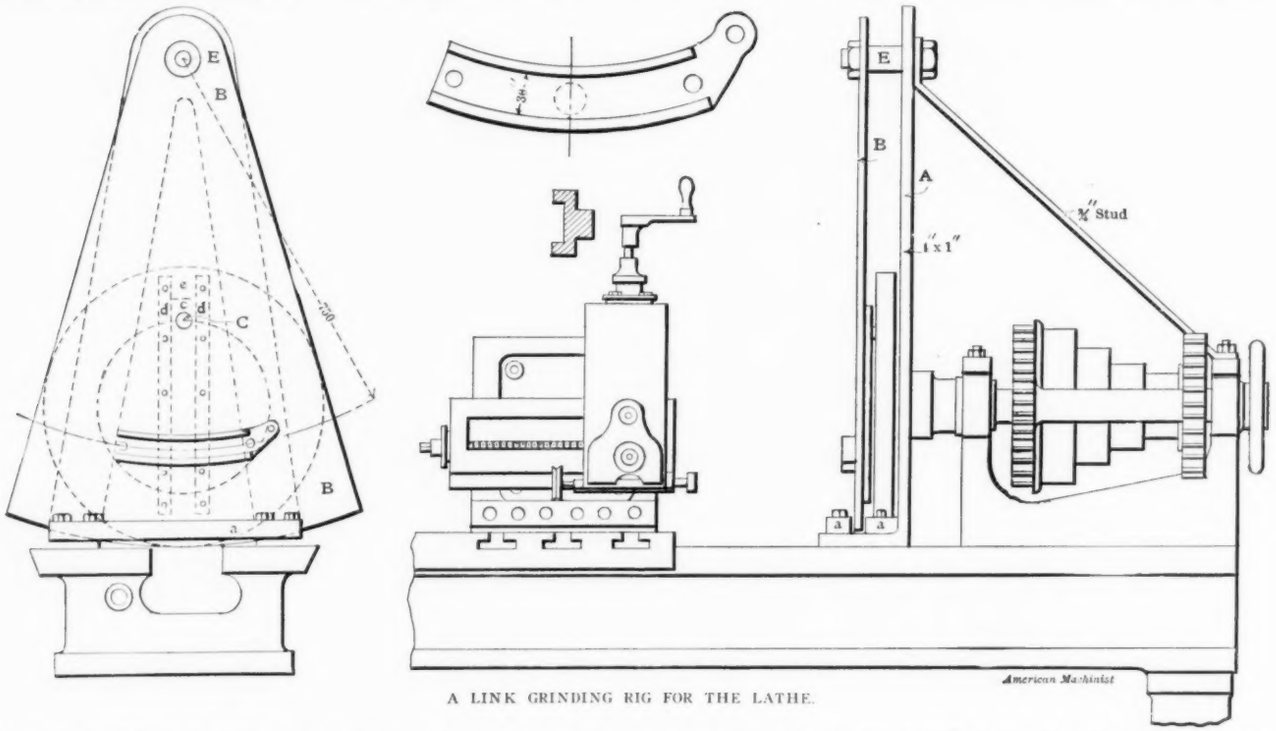
In regard to punching the paper, I have tried several punches made for punching belting but without success. I finally came across a hand punch constructed with a die and punch similar to those used in punching metal—in fact, they are made for sheet metal work; after that the problem of binding was solved, and six months of the AMERICAN MACHINIST can be bound in an hour and a half.

W. H. BRADLEY.

A Link Grinding Rig for the Lathe.

Editor American Machinist:

Some time ago I received the link-motions of some small locomotives to repair. The links were worn and I had to grind them to the exact radius of 750 millimeters. I designed a grinding fixture for a 24-inch lathe, which device gave us good satisfaction.



A LINK GRINDING RIG FOR THE LATHE.

A piece of flat iron *A*, 4x1 inch, is bent to a U and bolted to the lathe. A ⅜-inch plate *B* the form of a sector swings upon pin *e*. The square bars *a* act as guides. The plate gets its motion from the pin *C* bolted to the face-plate, with the block *e* that slides between guides *d*. The compound rest is bolted to a ¾-inch plate, riveted to angle iron. This provides vertical adjustment. The grinding wheel is fixed to a spindle (⅜-inch steel), which on the other end bears a small pulley and runs in a bronze bearing clamped to the rest.

JACOBS.

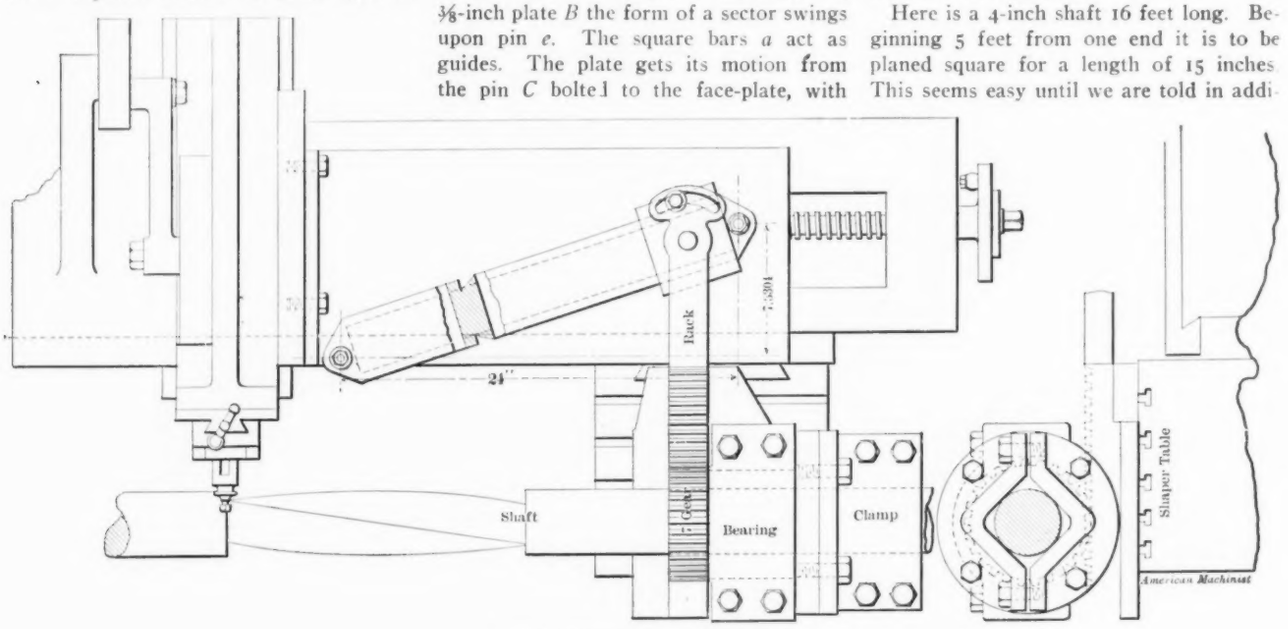
Manggar, Billiton, Dutch East Indies.

[Our readers will readily perceive that this device from the Dutch island of Billiton is equally well adapted to turning, and that it embodies a quick-return motion.—Ed.]

A Twisting Shaping Operation.

Editor American Machinist:

Here is a 4-inch shaft 16 feet long. Beginning 5 feet from one end it is to be planed square for a length of 15 inches. This seems easy until we are told in addition that the square part must have a twist in it at the rate of 120 degrees in 24 inches of length. The drawing shows how we did the job.



A TWISTING SHAPING OPERATION.

Now, we know it is customary to tell how "we found an old gear that was just

right, and then a piece of rack in the scrap and an old box that only needed a little fixing, etc.," but candor compels us to state that, with the exception of a taper attachment taken from the back of a lathe, we were obliged to make the whole outfit. The fixture is attached to a traverse shaper and the taper attachment is fastened to a plate which moves with the sliding head. The arm of the taper fixture carries a rack in mesh with a gear and the shaft to be squared passes through this gear and is fastened securely to it by the clamp, as shown. The clamp is attached to a flange on the gear casting which rests in a bearing on the shaper table. About the smallest gear we could use to give strength sufficient to turn this shaft was 7-inch pitch diameter, and 120 degrees of this pitch circle gives us 7.3304 inches as the distance to set over the taper, the distance between centers being 24 inches. The gear casting was bored large enough to allow the shaft to be pushed through easily and also to allow it to be turned around to another side of the square when the clamp was loosened. The other end of the shaft had a support not shown.

ISAAC MORGAN.

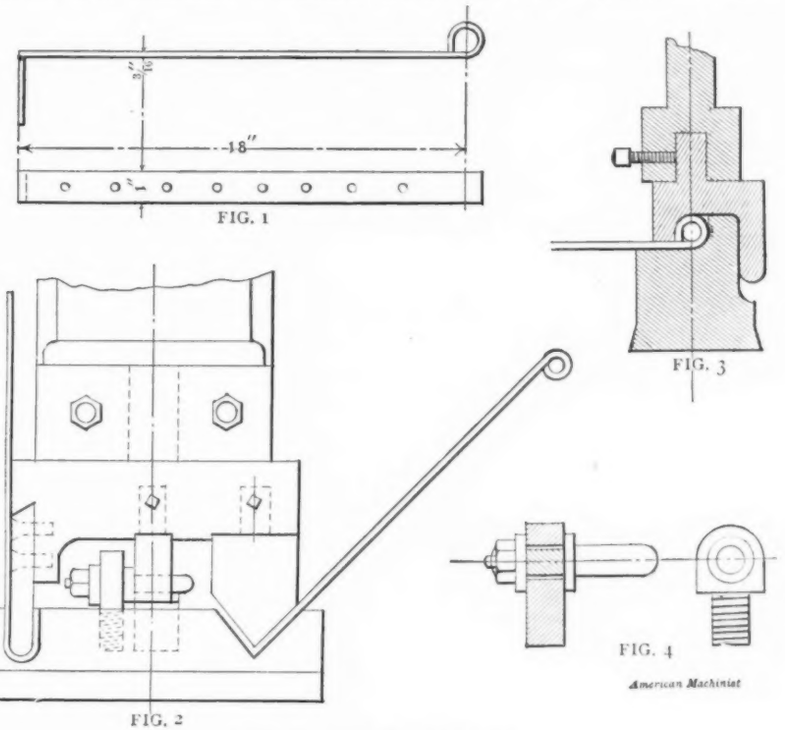


FIG. 1 FIG. 2 FIG. 3 FIG. 4

TRIPLE OPERATION BENDING DIE.

A Triple Operation Bending Die.

Editor American Machinist:

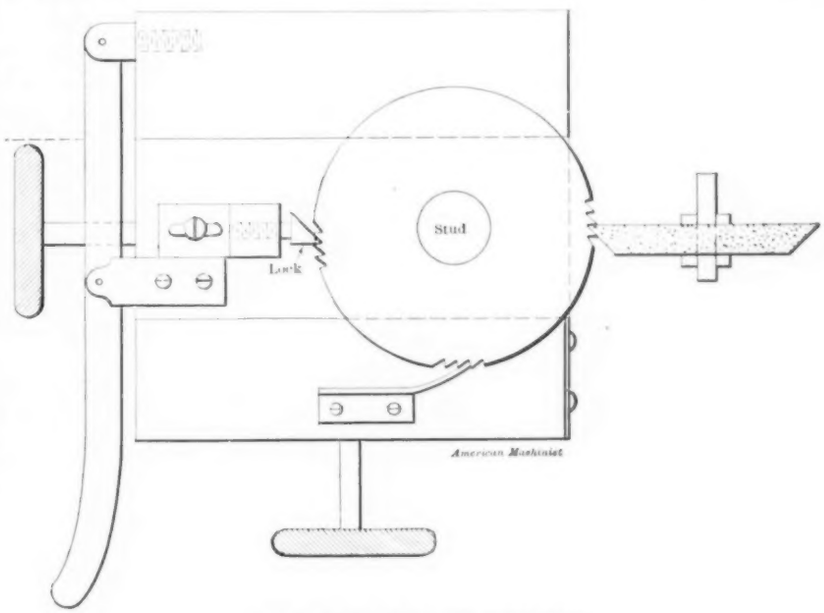
The sketches show a bending outfit for a hinge strap, of which a large quantity was used every year, it being made from 3-16x1 inch machine steel, 18 inches long over all, one end having an eye and the other end an angle bent on. To make a cheap and durable outfit, we proceeded as follows: A piece of tool steel was shaped to fit the bottom shoe of the press and cut out on the left-hand side for the first bend, see Fig. 2. On account of the length of the piece to be bent, this cut had to be made so far to one side as to allow one end of the hinge to swing up outside the ram of the press. Next to this on the same block is a projection forming the die for the second bend, and on the left of this a piece of ¾x1½-inch machine steel screwed into the block. This piece holds a hardened tool-steel pin which takes the place of the loose mandrel usually employed in doing work of this character, the pieces opening up enough after bending to slip off the pin easily. To accommodate the variations in the thickness of the stock, this pin has a collar on one side and a washer and nut on the other side, and the piece in which it is held has a hole 3-64 inch larger than the diameter of the pin, this giving it a chance to accommodate itself to the stock. To take the uneven strain off the press, as well as to make the die stand up to its work, the punch part for the second bend, made of a tool-steel forging, is constructed in such a manner as to hug the back of the bottom die before doing any work, see Fig. 3. The value of this will be apparent to everyone having had this kind of work to do. The third bend is simple, bending to an 85-degree angle, allowing 5 degrees for the springing of the stock. The punch holder is made of machine steel. The male part for the first operation is held in place by countersunk screws, and the other two, both being tool-steel forgings, have shanks turned on and are held by set-screws. This outfit will finish the piece in one handling.

FRED J. KUHLMANN.

A Metal-Saw Sharpening Device.

Editor American Machinist:

I send you a sketch of a device for sharpening saws used on milling machines. With this device, after I have fastened it down on the table of a Brown & Sharpe pillar grinder, I place the saw on the stud as shown, and adjust in each direction by the two milled head screws, so that the face of the emery wheel will be in line with the center of the saw. Then by operating the lever and moving the slide in the direction of the arrow, the spring pawl causes the saw to turn to the next tooth and at the same time the lock at the back snaps into a tooth-space and fastens the saw in position for grinding the next tooth. Then by carrying the lever forward another tooth is brought in contact with an emery wheel and ground as required. Care is to be taken not to heat the teeth, and in a very short time the saw



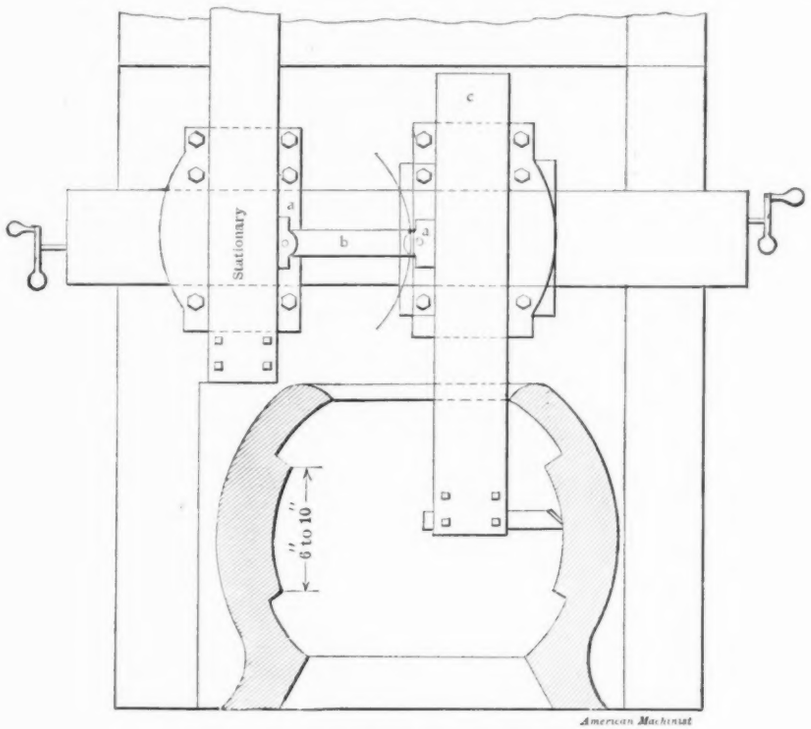
FOR GRINDING METAL-CUTTING SAWS.

is not only sharpened but the depth of the teeth is still retained, thus saving time and also saws. I have sharpened twelve saws 4 inches in diameter in 10 minutes. I learned after I had used this for some time that there is a machine for grinding circular saws on the same principle, but I had not seen it. E. A. BANNING.

A Spherical Boring Job on the Vertical Mill.

Editor American Machinist:

Having decided to bore our bearing pedestals spherically instead of straight to allow for self-alinement of the bearings and the problem of boring them having to be solved immediately and before experimenting with special boring bars, we decided to try one first on the vertical boring mill. Two cast-iron blocks like *a* were made, and also a connecting link like *b*, the holes in the end being apart a distance equal to the radius of the required seat. The blocks were fastened to the tool slides or bars as shown in the sketch. The left-hand slide is clamped rigid and the head locked to the cross-feed screw, the right-hand slide being free to move vertically as usual and horizontally with the saddle as the link moves it back and forth. The cut is regulated by moving the stationary head. The finish cut is run from top to center and bottom to center, thus keeping all parts in compression and making a true sphere. Needless to say the point of the tool must be central with the table, measuring horizontally from the face of the cross-rail. Also, as the tool is radial with bore only when in its central position, the point of the finishing tool should be as narrow as possible, otherwise its radius will be too great for the work diameter. These pedestals, from 12 to 36 inches diameter, are being done in this way in from two to eight hours each. G. R. L.



A SPHERICAL BORING JOB ON THE VERTICAL MILL.

Milling Dovetail Slides.

Editor American Machinist:

The accompanying sketches show a dovetail slide and a fixture for holding it while it is being milled. Fig. 1 gives side and end views of the work which has to be milled on the edges at *a* to form an angle with the bottom of 60 degrees, the bottom being planed before the casting reaches the milling department. Fig. 2 shows the cast-iron fixture for holding the work, both work and fixture being shown in place on the miller table in Fig. 3. The piece to be milled, when placed in the fixture, rests against the hardened and ground tool steel strip *b*, and is held in place by clamps *c*. The work is raised until the tool-steel gage or dummy *d* is within .025 or .030 inch of the cutter, for the roughing cut on one side, and then raised half of this amount for roughing the other side, leaving from ten to fifteen one-thousandths for finishing cuts—five to seven one-thousandths on each side. This allows them to be finished rapidly and accurately, and by the use of two fixtures the machine is kept constantly on the move, as the operator takes out one piece and puts in another while the cutter travels over the other piece. It will be noticed that the tool-steel dummy *d* prevents the operator from spoiling any of the pieces, as the cutter is set altogether by it. After the pieces are all roughed on both sides and finished on one side, the knee of the milling machine is raised until the dummy comes right up to the cutter, when the knee is locked, and left that way while

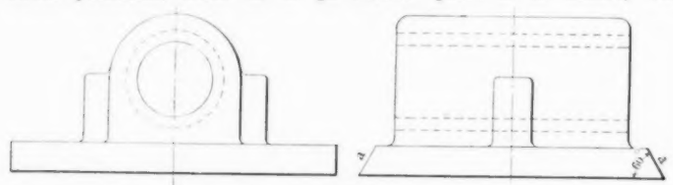


FIG. 1

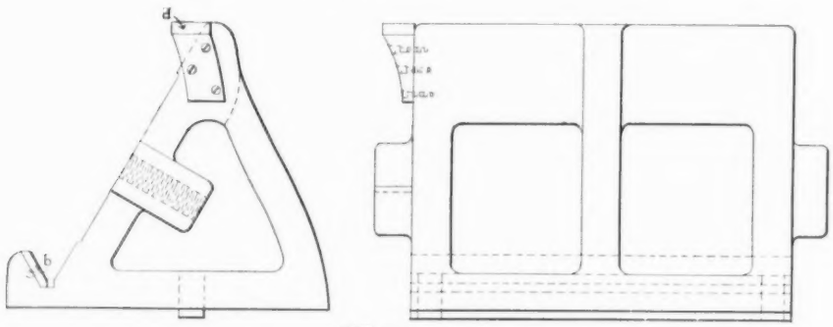


FIG. 2

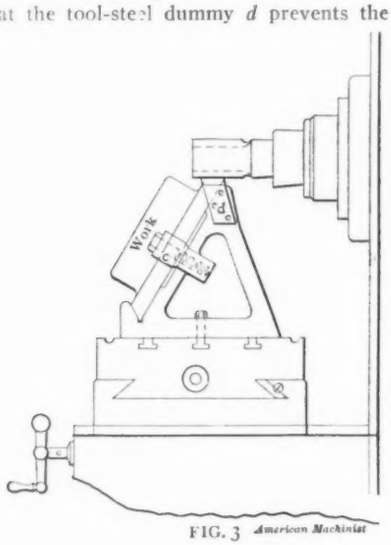


FIG. 3

FIXTURE FOR MILLING DOVETAIL SLIDES.

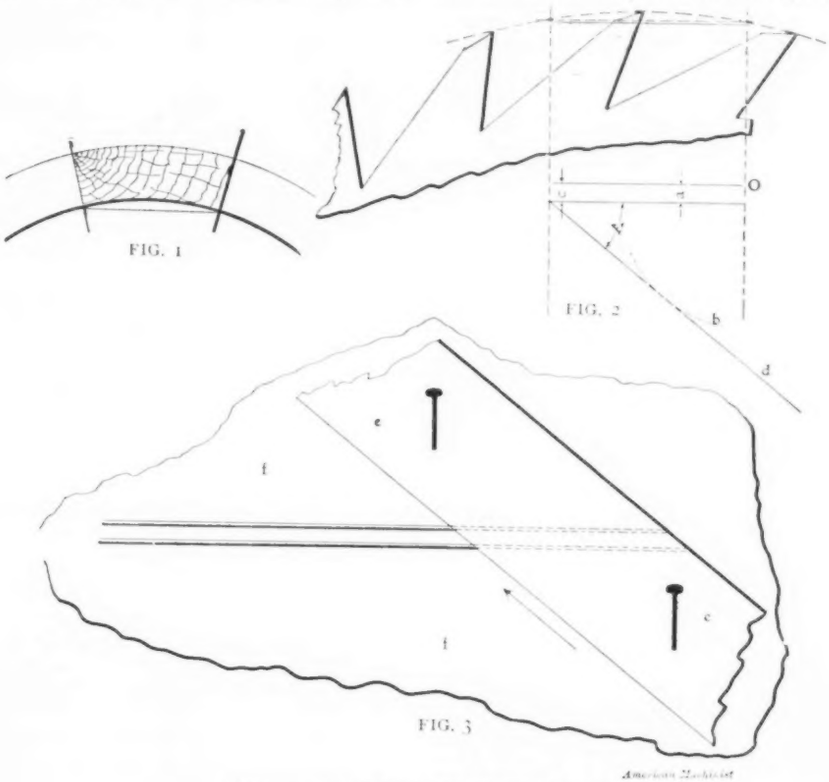
the last cut is taken over all the castings, the dummy being set so that this cut brings all the pieces to the correct size.

JOHN A. CAMM.

Concaving Staves by the Circular Saw.

Editor American Machinist:

The advantage of using the circular saw for concaving staves has been fully demonstrated in your paper, but as the angle required to pass the work over the saw varies with the radius of work or saw or both, it is well to know of some quick way to lay out the proper angle.



CONCAVING STAVES BY THE CIRCULAR SAW.

The accompanying sketch shows a simple method of finding the angle for all work of which the radius is less than that of the saw. Fig. 1 shows the stave with the material to be worked away, and Fig. 2 shows enough of the saw to find the length of the chord of an arc whose hight is the same as that of the stave cut, the thickness of the saw being shown underneath at *a*. The necessity of knowing the thickness is apparent when we consider that the work is to pass the saw at another angle than a right angle.

Take the length of the stave chord in the dividers and from point *o* as a center describe an arc *b*. The points of the saw teeth on the farther side of the saw come through the surface of the table at *o*. From the point *c*, where the points of the nearest side of the saw teeth come through the surface of table, draw a line *c d* tangent to the arc and thus find the angle to be transferred to a suitable guide strip *e*, to be tacked down to the table *f*, so that the angle line drawn across its surface shall be in the same plane as the path of the saw.

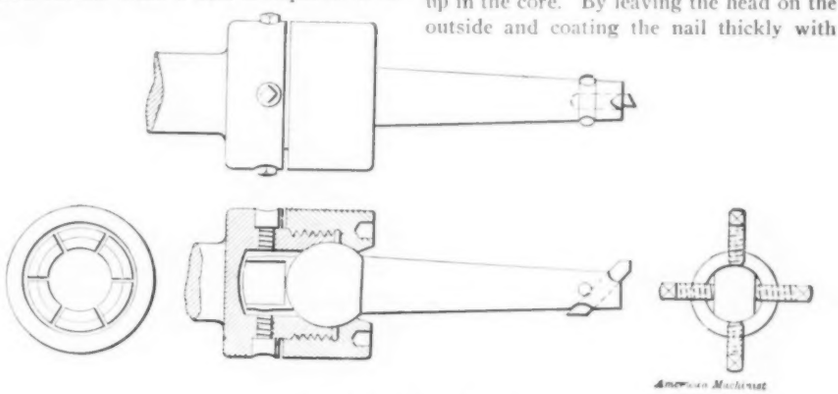
If the radius of the staves and saw were the same, nothing need be done but pass the work at right angles to the saw, and the same would have to be done if the radius of the work were more than that of the saw. In such cases the versed sine of the arc made by the saw would of course be too great, but it would allow the staves to be seated without any rock. In practice the difference is found to be so little, in most cases, that it is not noticeable.

WM. NEWTON.

An Adjustable Single Pointed Boring Tool.

Editor American Machinist:

This tool is most reliable and gives very good results when a hole is required to be made perfectly true before reaming. As will be noticed from the drawing, it has a ball and socket joint, and when this is firmly screwed up, the set-screws will adjust the tool as desired and all will be very rigid.



ADJUSTABLE BORING TOOL.

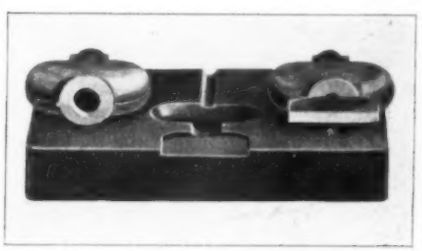
The tool is suitable for the capstan lathe where it is necessary to true the hole, after a roughing cut has been taken, to make ready for the reamer. It is also useful for the drill press and is indispensable on the jig boring machine. The tool is shown assembled, the sectional view showing clearly how the body and cap are made, while one end view shows how the screws are in contact with the end of the bar, which is case-hardened. The shank can of course be made to suit requirements. It is necessary to have a feather in the ball part of the tool bar to prevent the bar from turning when the cap is being tightened up, and this feather should be in line with the front or back of the tool in the bar. The feather is not shown in the drawing, it being an addition since the drawing was made.

B——, England. H. DUROSE.

One Way of Holding a Core.

Editor American Machinist:

I send you photograph of a casting, the pattern and half the core box for an eccentric oil cup which needed to be flat to work within a limited space, and must also be spread out so that it would hold sufficient oil for a day's run. By making the point on the large end flat and wide and the core box to match, the core was held from tipping without using anchors. We used for the small hole a nail, about 5-32 inch diameter, which was rammed up in the core. By leaving the head on the outside and coating the nail thickly with plumbago, it was readily pulled out, leaving the hole smooth enough. We had a few of these blow, but on the whole the job was a success.



THE CASTING, PATTERN AND ONE-HALF OF THE CORE BOX.

J. L. GARD.

An Automatic Chuck.

Editor American Machinist:

Figs. 1, 2 and 3 are side, front and cross-section views of a newly designed automatic chuck for holding small hand-wheels, as shown in Fig. 4, while being turned in an automatic turret lathe. The advantages claimed for this type of chuck are effectiveness, durability, compactness, simplicity of construction, and ease of manipulation.

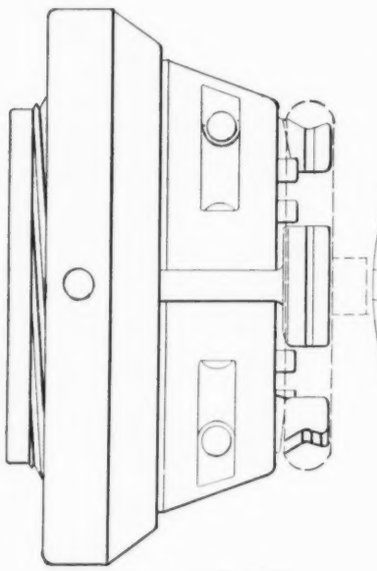


FIG. 1. SIDE VIEW.

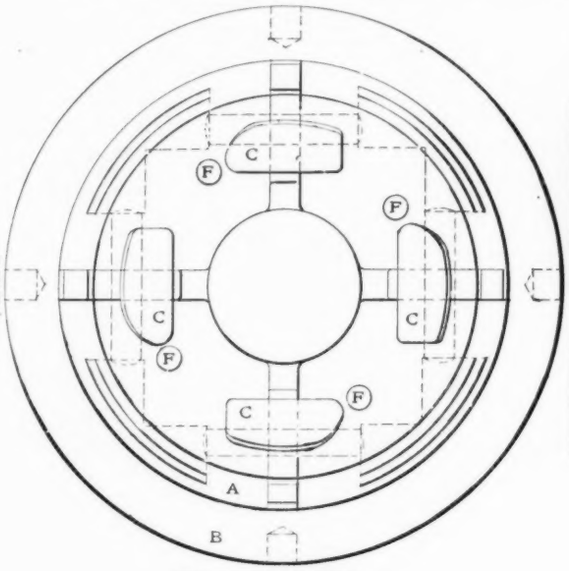


FIG. 2. FRONT VIEW.

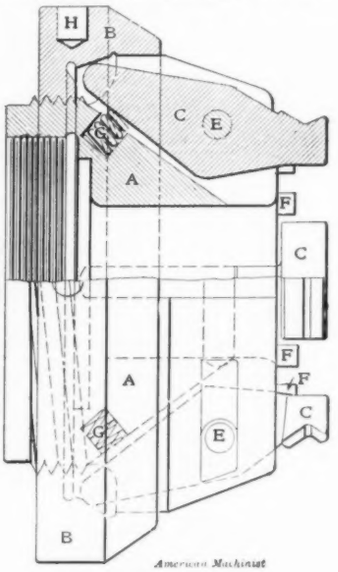


FIG. 3. PART SECTION.

It is built entirely of steel, the body *A* and outside ring *B* of machine steel, while the four jaws *C* and pins *E* are of tool steel to insure greater stiffness as well as for hardening. The inner face of ring *B*, where it comes in contact with the ends of the jaws, is case-hardened and ground true with the tread to insure uniform motion of the jaws, which are moved by the insertion of a lever in any of the four holes *H* in the ring *B*, and when this is moved in either direction a quarter of a turn it is sufficient for tightening or loosening the ends of the jaws *C* on the wheel. The inner thread in the body of the chuck *A* is for the spindle of the lathe, and made to fit over it nicely as well as a narrow recess that fits over a plain part on the spindle to insure its running true. The chuck may be cased in with a covering of sheet brass or tin on the outside and inside to prevent the dirt from clogging the working parts. Other details are obvious from the drawings. H. ROBINSON.

FIG. 4. THE HAND-WHEEL.

A Spherical Boring Tool.

Editor American Machinist:

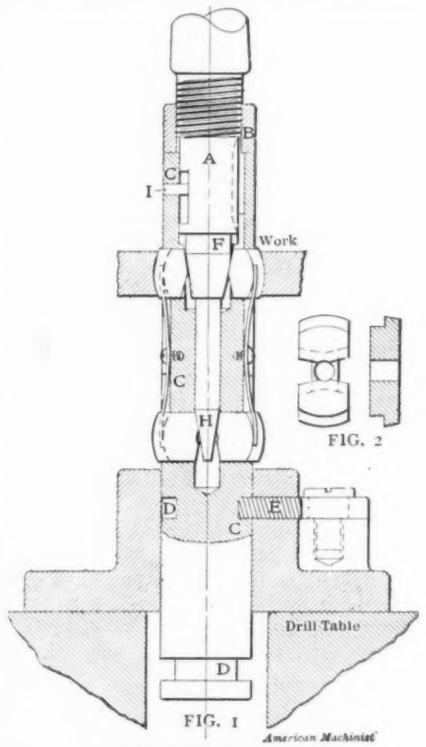
The spherical boring tool described by Mr. Flynt at page 9 calls to mind a device which has been used successfully for finishing internal spherical surfaces in a form of shaft hanger. The tool here shown is possibly a simpler and quicker means of doing this work. A tool-steel spindle *A*, having a Morse taper shank fitting a drill press spindle, is threaded to receive a nut *B* and is reduced below the thread to receive a cutter arbor *C*, which is splined to slide upon it and is provided with two mortises to receive the adjustable forming cutters. This cutter arbor has two grooves *D* turned at its lower end, equidistant with the mortises referre l to. A swiveling yoke *E*, secured on a stud in the collet which supports the arbor, serves to retain the arbor in the proper vertical positions.

The spindle which fits the cutter arbor is made tapering at *F* and *H* to bear against the backs of the forming cutters. The longitudinal movement of this spindle within the cutter arbor will of course impart traverse movement to the cutters.

This longitudinal movement is limited by the nut and by the arc-shaped key *I*, which fits into a slot milled across the arbor and engages the notch milled across the spindle. The cutters are depressed and held against the tapers of the spindle by flat springs let into slots milled along the sides of the arbor. It will be seen that the nut may be backed upward, allowing the spindle to enter farther into the arbor, thus slightly varying the diameter of the hole to be bored, which is of course necessary as the cutters wear.

The lower or roughing cutters are first brought into position for the work, and the swiveling yoke *E* is inserted into the lower groove *D*. The drill press spindle is then fed down until the nut abuts against the arbor. This gives the proper diameter for the roughing cut. The drill press spindle is now backed off until the cutters clear the work sufficiently to allow them to pass out, the yoke is then withdrawn, the finishing cutters are lowered to the work and the former operation is repeated.

A cheap and accurate way to make these cutters is indicated in Fig. 2. Flat pieces of tool steel are bored, turned and milled as shown, and after hardening and lapping

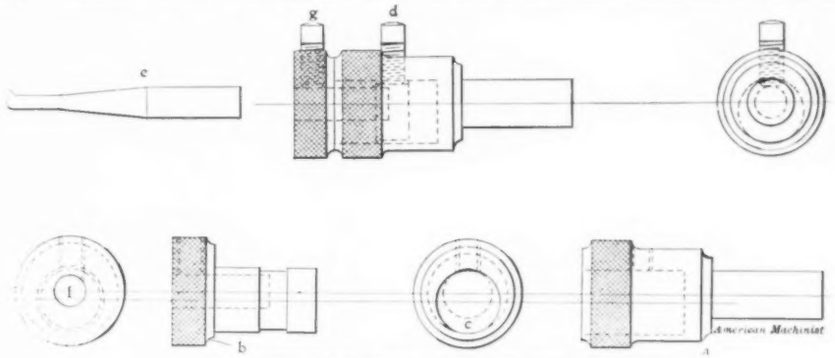


A SPHERICAL BORING TOOL.

the holes, they are ground to size and tapered for clearance, the roughing cutter made about .008 inch smaller than the finishing. They are now broken apart and the backs are ground to suit the taper of the spindle against which they bear.

A good example of spherical bearings can be found in the Wilcox & Gibbs sewing machines. These bearings are provided with caps, and when made in this way it would seem that milling them is the proper method, on account of the ease in getting an exact hemisphere in both the rod and cap.

W. L. SCHELLENBACH.



AN ADJUSTABLE BORING TOOL FOR THE MILLER.

An Adjustable Boring Tool for the Miller.

Editor American Machinist:

A boring tool which is comparatively inexpensive and gives excellent satisfaction is here shown assembled and in detail. When we first began making drill jigs, using the vertical attachment on the milling machine for drilling and boring the holes for the bushings, we felt the need of a sensitive boring tool. A crude tool was made at first, and it gradually developed into the one shown. The shank of the piece *a* is held in the chuck. The part *b* fits into the hole *c* and is held in place by the set-screw *d*. The tool *e*, which may be varied in size and form as the size of the hole and the shape of the piece to be bored may require, fits into the hole *f* and is held by set-screws *g*. The hole *c* in part *a* and the shank of *b* are each 1-16 inch off center, so that the size of the hole which the tool will bore may easily be changed by loosening the set-screw *d* and turning the part *b*, thus throwing the cutting edge of the tool in or out, as the case may require, without removing the tool from the chuck.

Our experience has been that when this tool has been given a fair trial the workman prefers it to any other.

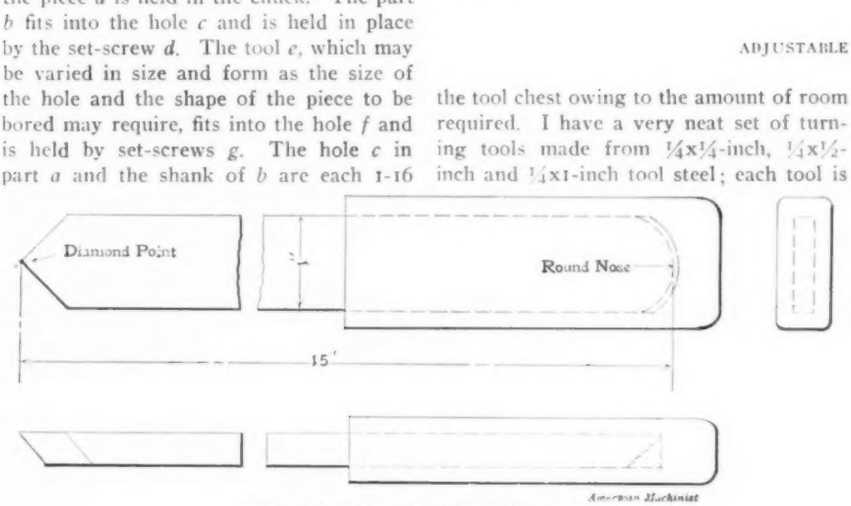
C. L. NORTHWAY.

Turning Tools for Patternmakers.

Editor American Machinist:

Nowadays patternmakers make tool chests as small as possible and at the same time carry all the tools they require by economizing in size of handles, etc. A set of good turning tools is handy and necessary, but few like to lug them about in the tool chest owing to the amount of room required. I have a very neat set of turning tools made from ¼x¼-inch, ¼x½-inch and ¼x1-inch tool steel; each tool is about 15 inches long and shaped on both ends. Some object to the double-end tool as being dangerous to work with, but I have provided a handle that overcomes this objectionable feature. The sketch shows the idea, and the reader will see that the tool reaches almost to the end of the handle, which is made a snug fit so that it may be slipped on and off. The handles can be made of wood or leather, one for each size of steel.

REX.



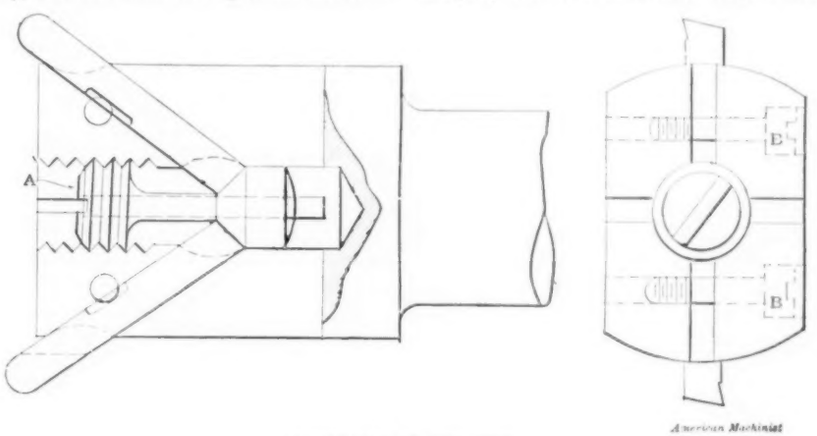
TURNING TOOL FOR PATTERNMAKERS.

An Adjustable Boring Tool.

Editor American Machinist:

I enclose sketch of an adjustable boring tool which I made for use in the turret lathe. The body is of mild steel. The two cutters are simultaneously adjusted by means of the screw *A*, the taper portion of which, when the screw is drawn forward, presses against the ends of the cutters and forces them outward. They are clamped in position and prevented from turning round by the screws *B*. The idea will be fully understood from the sketch without further explanation.

PLANET.



ADJUSTABLE BORING TOOL.

Lubrication of Press Tools.

Editor American Machinist:

Perhaps a few words on the above subject will be of interest to those of your readers who are press users. When a diemaker has finished a die, his interest in the job is over. He may like to see a few samples, but he doesn't care what is used on it; but the foreman of the press room does, for it makes a lot of difference to the output.

For all cutting dies on brass or steel, a heavy animal oil will be found best. Lard oil is all right, except the price.

For punching or repunching copper, milk, either sweet or skimmed, is very good. Sometimes it is not possible to get the work out good without it. It seems to have an effect on the stock that cannot be produced by any other lubricant.

In drawing brass or copper, a good, clean soap water will have the best results. A formula used by one of the largest brass firms in the country is as follows: Put 15 pounds of Fuller's soap in a barrel of hot water and boil until all lumps are dissolved and then use as hot as possible. If the work can be allowed to lie in the water until a slime has formed on the shell, it will draw all the better. A soap that is strong in resin or potash will not give good results.

In drawing steel shells a mixture of

equal parts of oil and black lead is best, and while it may be used warm, it does not affect the work as much as the speed of the drawing punch does, and the thicker the stock the slower must be the speed of the punch.

If the drawing die is very smooth and hard on the corner of the "draw" or edge of the die, the liability to clog or "copper up" will be reduced to a minimum. Often it will help to give the die a lateral polish by taking a strip of emery cloth and changing the grain of the polish from circular to the same direction as the drawing.

In drawing zinc, the water must be hot or the percentage of broken shells will be large.

Aluminum is an easy metal to draw, except it hardens up very quickly, and for a lubricant there is nothing better than "Albany grease," so called, and don't be sparing of it.

To anneal the shells, put in an oven and heat to the same heat used for baking bread, so that a clean pine stick will make a mark when drawn across the shell.

There is a preparation called "Drawline," made and sold in Philadelphia, but I am unable to give the address of the firm making the same. A. P. PRESS.

Newspaper Engineering.

Editor American Machinist:

Is it not surprising what new marvels are prepared for the gullible public to swallow almost every day, and especially for the engineering fraternity? I think your readers will gasp when they read this cable dispatch to the *Chicago Tribune* [copyright, 1904, by the *New York Herald*] and wonder what they have been doing all these years:

"London, Jan. 16.—Particulars are published here of a wonderful new motor invented by Peter Thornley, a Burton-on-Trent engineer. The invention is considered of such importance that its development may result in express and railway engines running twice the present speed at only half the cost, or of Atlantic liners crossing from Liverpool to New York in three days.

"The motor is almost small enough to be carried in a typewriter case, and is so compact that everything is inclosed except the driving wheels. The new motor is capable of developing 1,500 revolutions a minute, and giving 15 horse-power under a boiler pressure of 200 pounds to the square inch.

"In even the best railway locomotives the steam is admitted after the piston has moved from 5 inches to 8 inches along the cylinder, thus forming a vacuum of several hundred cubic inches in extent to be filled up before an ounce of power is exerted.

"Thornley has devised a valve which will admit a given quantity of steam every commencement of the stroke, and is so nicely adjusted that the expansive force of the steam admitted is just sufficient to drive the piston at the end of its journey. The most modest estimate of the saving in coal is 25 per cent., while the simplicity of the motor is such that the initial cost is much cheaper than the existing types. It is actually claimed that 1 ton of coal will produce as much power as 8 tons with the existing types. It can be worked just as well with compressed air as steam."

I did not think it necessary to give the loud headlines to the article, as these may easily be imagined, and if all do not imagine alike it will make no difference.

VETERAN.

Don'ts for Jig and Fixture Makers.

Editor American Machinist:

Don't think that because a milking stool stands better on three legs, that the same rule applies to a jig. Chips and dirt are liable to get under and remain undetected, impairing the accuracy of the work.

Don't have unfinished surfaces of the work bear on more than three permanent points in the jig. All other points should be adjustable.

Don't have the clamps bear anywhere except where you want them to.

Don't put in more sizes of clamp screws than are necessary. Make one wrench do for all, if possible

Don't think that "pretty close" is "good enough" when a jig requires great accuracy in its construction.

Don't spend valuable time for the sake of getting an exceptionally accurate job when it is unnecessary. Study the requirements and do the work accordingly.

Don't think that because some other fellow uses different methods to get the same results, his way *may* not be as good as yours.

Don't argue with the man in charge when he gives you explicit orders as to what is required. He usually does his thinking before giving the orders.

W. E. WILBER.

Making Piston Rings.

Editor American Machinist:

Probably the jobbing or repair shop man is called upon to devise ways and means rather out of the ordinary more frequently than any other mechanic. The common way of turning piston rings large, sawing out a piece and then of clamping them to a face-plate and turning to the size desired requires too much time when only one or two rings of a size are made at a time; and yet to dispense with the second turning leaves the ring a bad fit, for in closing it will become flattened somewhat.

By turning the rings to fit the cylinder, allowing for a hacksaw cut only and then carefully peening the ring all around the inside, the proper spring is imparted and the ring is a good fit. I have never had a ring break on account of this peening and the work of making is reduced to a minimum. REPAIR SHOP.

Some Human Nature in a Machine Shop.

Editor American Machinist:

About ten years ago the concern with which I was at that time had the job of building an experimental typesetting machine of a new style. It was necessary to build a similar machine in Canada, to comply with the patent laws there.

It was finally decided that Montreal was the most convenient, so communication was opened with several of the shops there regarding the rental of part of some shop, inclusive of the necessary machinery. The supervision of the construction of this machine was to be in the hands of a man thoroughly conversant with it and entirely out of the hands of the superintendent or foreman of shop so engaged. After inspecting a number of shops, a contract was finally entered into with one of the concerns most suitably equipped, which contract specified that the machinery required to complete this machine was to be located, centralized and put under power in some particular part of the shop that was to be designated by the master mechanic sent on from New York, and a requisite number of mechanics detailed from the shop proper or newly hired to operate the machinery so set aside and hired for the purpose, and that the work was to be done under the direct care of their master mechanic, and that the foreman was not to interfere with the men or machinery so detailed.

The contract also stipulated that after the machinery had been selected with the assistance of the regular foreman of the shop, he, the foreman, was instructed to shift and put this machinery under power as directed immediately after the selection was made.

On my first visit of inspection to this shop, in conversation with the foreman regarding the machinery to be selected and what he could spare, he personally conducted me through the works, and told me to go ahead and select whatever I felt was required, so that, provided everything was satisfactory and the contract secured, there would be no friction regarding that matter. I made a memorandum of tools, etc., that I thought would be required, and gave him a copy, which was satisfactory to him, and returned to New York and reported.

Immediately upon the signing of the contract I returned to Montreal, repaired to the works, saw the foreman, told him that everything was "fixed" and that the machinery I had selected had best be moved and put under power as per my memorandum, so that by the time the "stuff" (brass, etc., purchased in New York) got through the custom house there would be no delay in getting to work. I furnished him with a diagram giving full particulars of how the machinery selected was to be placed, and the speeds, etc.

Right here the trouble started. He denied my giving him any copy of such list of machinery, and I looked at him in

amazement. I furnished him with another copy from the memorandum I had, and then he told me "he could not spare the machines as he wanted to use them himself." Shortly before, on my previous visit, he had told me that he was "glad if they got that job because they didn't have a deuced lot to do, and that the men and machinery would have been idle," etc. I really could not understand what he was driving at when he told me that, so I asked if "he had any he could spare at all?" Then he got "mad," and told me that "he didn't like to take any orders from anyone that was younger than he was, and a *kid* like me, and that he'd be d—— if he'd do a tap that I had suggested," etc., etc. I didn't bandy any words with him, as he thoroughly understood the situation and his connection with it, but told him he had my memorandum and it was up to him whether he had the machinery and other things ready by the time the "stuff" got through, and that I saw any amount of trouble for him and his employer if things weren't in shape by that time. I left him and returned to New York and reported.

Upon notification from the Canadian customs that the "stuff" was to be cleared, I left for Montreal again and dropped in at the works to see if my amiable Scotch friend, the foreman, had made any move, but found things as before—"nothin' doin'." I had a heart-to-heart talk with him, but could not induce him to do anything, so I hunted up the owner and told him about being held up by his foreman, and that I wanted the changes agreed upon made immediately, as I intended going to work by the following Monday; and that if things were not ready by then it would be his responsibility.

Monday morning I went down to the works, and, as I had expected, the changes had been made; so I saw the foreman and requested that he assign the men to me that we had agreed upon. Here we had another wrangle, he repeatedly asserting that he wouldn't take any orders from a kid; that he knew his business, etc., etc., all having no bearing on the business in hand. I let him rave until he got all through, and then asked again for the men, and told him that if they did not report to me within a certain time, I would immediately telegraph to my people in New York about having the work transferred elsewhere. That brought him around, and the men went to work.

The understanding in connection with the men so assigned to me was to the effect that I was to keep track of their time, and at the end of each pay week to turn over to the foreman my time sheets, so that their time would go in with the others, and there would be no delay or holding up of their pay. An extra charge for such labor actually employed on my work was sent each week to my home people by myself. At the end of my first week I turned over to the foreman my time sheets, as stipulated in the contract, and was surprised, when Saturday came, to have the men working for me complain that they had not received any pay. I immediately saw the foreman, and told him that I intended having these disagreeable happenings stopped at once, and that he had better reserve his explanations, if he had any, until Monday, when someone would be on hand to hear them beside myself. I paid the men off. In answer to my telegram, our manager at the New York end came on at once, and there was a "hot time" in Montreal that Monday. The only excuse was that same old thing—that he did not want to be "bossed by any *kid*."

With the advent of our manager and a thorough understanding with the owner and his foreman my troubles stopped, and with the exception of a few minor incidents my time spent at that place passed agreeably enough. To this day I have never been able to explain the peculiar attitude of that foreman regarding something that he had nothing to do with, directly or indirectly, as the work we were doing was independent from his in every respect, and there was no interference or conflict of the two classes of work. When I left for New York, after completing this machine, we did not part as friends. Why? I don't know. A. C. R.

Mechanics as Machinery Salesmen and Advertisement Writers.

Editor American Machinist:

It seems that most office subordinates of the present machine concerns are chosen from the ranks of young men having some clerical knowledge, and it has often occurred to me that the office manager could help himself and also help to give the shop an occasional example of encouragement by calling in the shop man to fill the many vacancies which are always occurring. It appears to me that the shop and office should be drawn closer together. The office correspondent should know how to dictate letters touching on technical matters without troubling the superintendent with a number of foolish questions. The salesman should have shop experience—not three weeks in a white shirt and linkcuffs, but three or four years in overalls—an apprenticeship, if possible. The young man from the vise or lathe can certainly develop into a better salesman than the stenographer even if he don't know so much about proper English. He will acquire the English quicker and better than the stenographer will acquire the knowledge of doing machine work. There have been, and are to-day, good tool salesmen who are not mechanical, but they would certainly be better with the knowledge.

Doubtless a great many of your readers have been up against the modern embryo machine-tool salesman who was previously the office boy or stenographer and who when becoming fairly conversant with the terms used in describing machines is sent out with his little book of dimensions and prices to get business. Most often this young man is chosen to become a salesman for the following reasons: First, a practical young man who has served an apprenticeship would want a salary of about fifteen dollars per week and the manager of the office cannot pay more than ten; second, the young man reared in the office has had more experience in dealing with office men and is usually thought to be better qualified in the way of little conventionalities than the shop man.

He is sent out first to do local work with instructions not to talk too much—"let the other fellow do most of the talking," etc. The above advice he seldom heeds and at the end of three days he imagines himself a salesman and begins to try to imitate salesmen he has seen in their office. He will come into the shop wearing the fixed smile, hand you his card, and begin to talk very profusely. He has forgotten the advice and is anxious to impress you that he knows his machine from "A to Izzard." He always carries an "ointment" in the form of cigars, so you take one to avoid hard feeling and ask him about a certain machine which you know their firm manufactures. This is enough—he will proceed to tell you all about it. You have read what he has to say in the circulars because that is where he got his knowledge and you are getting anxious to attend to something which needs your attention, so as your interest diminishes he will take hold of your arm to keep you from getting away and missing the chance of a lifetime to soak up wisdom. You begin to suspect that this chap is pretty fresh, so when you finally get an opening you say, "You haven't been selling tools a great while, have you?" He will of course ask you if he acts like a novice, and you will try and assure him to the contrary, but it does not satisfy him and with a reminder "not to forget them when in the market" he is gone.

When in a machinery agent's store I was once examining a lathe which I had designed, when the manager whom I did not know, a young man with more experience than the type above referred to, politely offered to show me the tool. After the usual large and long bearing and deep bed story, I asked if seven threads per inch could be cut. He did not know and seemed rather confused, and after a hurried glance at the index he said the lathe did not cut seven threads, as it was not needed. I let it go at that and am reasonably sure that he afterwards found that a 1⅛ standard thread could be chased on his lathe.

If the office manager would draw from the machine shop for his advertisement writers and salesmen, we fellows who are responsible for the equipment would have more interesting men to meet and more sensible advertisements to read. The "Old

Man" tells us that the AMERICAN MACHINIST has experienced men for writing "ads.," but I think these men are not very popular with machine-tool builders, for we don't want to charge them with "ads." about like the following: "Horizontal Boring Machines—All holes can be bored in one side of the work without rechucking." We might ask the builder of this tool if he ever saw a machine of this character which didn't fill the above description. It would be just as sensible to advertise a lathe and state that work could be turned cylindrical in it. Another builder of a machine tool tells us that his tool is so designed and built that it is impossible to lose money on any job put on it. This may seem a great advantage to the office man, but to "the man behind the gun" it is "South breeze."

ART. ISAN.

High Speed Steels—Cost and Saving.

Editor American Machinist:

High-speed steels have recently received so much attention that one might be led into the error of believing that they had generally superseded the carbon steels for all shop purposes. That they have not done so is evident, and the reason for it is, among other things, the high price demanded for the steel.

By the aid of data I have recently collected, I will endeavor to show that though the initial cost of high-speed steel is considerably greater than that of carbon steel, the saving on the increased production secured by its use more than offsets the difference in the first cost. The following figures were taken from operations on machinery steel, the cutters being well supplied with oil from circulating pumps. In the examples of milling given here the cuts were short, in no case exceeding 2½ inches in length, making the handling a large factor and accounting for the prices not being reduced in the same ratio as the speed was increased.

(1) A pair of 3½-inch straddle mills beveling the edge of sheet stock .150 inch thick; cut 2½ inches long; speed, 247 feet per minute; feed, .033 inch per revolution or 7.8 inches per minute; cost of pieces reduced from 42 to 28 cents per hundred.

(2) Cutter, ¼x3 inches; speed, 205 feet per minute; length of cut, 1¼ inches; depth of cut, ¼ inch; feed, 7.8 per minute; cost of pieces reduced from 60 to 40 cents per hundred.

(3) A face milling cutter, 3½ inches diameter; speed, 207 feet per minute; feed, 7 inches per minute, with work feed parallel with face of cutter giving large arc of contact; cutter and work both highly heated; chips blued; cost of parts reduced from 60 to 40 cents per hundred.

(4) A pair of 3½-inch straddle mills; speed, 270 feet per minute; cut, ¾ inch long; hand feed; cost of parts reduced from 15 to 10 cents per hundred.

(5) Forming tool on automatic screw machine operating on 1¼-inch stock at a surface speed of 130 feet per minute; width of cut, 1⅛ inches and a reduction of 1 inch in 80 seconds gave a production of 3 to 1 in favor of high-speed steel.

The facts and figures given above were taken from every-day practice, and are not the result of tests where the speed was increased only for the time the tests were on.

The cost of the cutters of course was greater than if made from carbon steel, but in no case did it require more than the savings on a five-day run to place them on an equal footing. In giving the result of the foregoing trials in dollars and cents I do so expecting it to show the gains more clearly than by a table of speeds and feeds, and thereb pave the way to a more extended use of the greatest cost reducer of them all. H. HUGH.

Special Jobs of Case-Hardening.

BY E. R. MARKHAM.

As several parties have written me desiring information regarding the possibility of case-hardening articles that have been brazed, I thought it might interest some of your readers to know my experience in this line.

At one time it was found necessary to stiffen some short shafts which had a flange brazed on them. It was found when too late that the stock from which the shafts were made was not of the kind ordered, and they would not stand the working strain without twisting. I do not suppose the heat they received while being brazed helped them any; in fact, they were stiffer before being brazed than after.

Several experiments were tried with the purpose of stiffening them sufficiently. First we heated several of them and plunged them into oil, but without accomplishing the object desired. Then several were heated and cooled in water with results very little different. It was then suggested that we try case-hardening them.

Two or three of the shafts were packed in a hardening box, using charred bone as packing material. They were placed in the furnace and run after they were red hot for four hours, at a low red heat, then removed and plunged in oil; the results were all that could have been desired.

Of course we could not run the pieces at nearly as high a heat as they were subjected to when being brazed; in fact, not high enough to melt the brazing, and it was an easy matter to keep the heat low enough to prevent the brazing melting, and yet high enough for the metal to become charged with carbon.

At another time I had some cam-shafts to case-harden; the cams had been brazed to the shaft. It was necessary to harden the cams quite hard and deep, the balance of the shaft except the bearing was desired soft. We covered the portions of the shaft to be left soft with fire-clay mixed with water to the consistency of dough, winding iron binding wire into the clay to keep it in place when the heat was applied. The clay was allowed to come up the sides of the cams beyond where they were brazed. These shafts were then packed in a box with charred bone and run eight hours after they were hot. The box was removed from the furnace at the expiration of the time mentioned, and the shafts were allowed to remain in the box until cold. The packing material was removed from the box, but the shafts were left in and the cover was put on. The box was then placed in the furnace and left until the shafts were heated to a uniform low red heat, when they were removed one at a time and plunged into a bath of water. This bath had perforated pipes coming up the sides, and the water coming out through the perforations was projected against the shaft very uniformly and the results were satisfactory.

The examples given illustrate two entirely different results sought on pieces that were both brazed and show that such work may be case-hardened and the work prove satisfactory. I have been called on to treat work of other descriptions than the two examples given, but they suffice to prove that if care is exercised the work may be done.

While many mechanics know that it is possible to case-harden *cast iron*, I have met many who didn't know it could be done in a practical manner on a large scale. They had read in some hand-book that cast iron should be heated red hot, then sprinkled with a composition of prussiate of potash, sal-ammoniac and saltpeter equal parts, then plunged in a bath containing 2 ounces prussiate of potash and 4 ounces sal-ammoniac to each gallon of water, but did not know that cast-iron rolls and similar work could be successfully case-hardened by packing in a box with *raw granulated bone* and treating the same as when case-hardening pieces made of machinery steel; yet such is the case.

I have seen a method used in case-hardening articles made of wrought iron and *low* carbon machine steel which the parties using claimed gave excellent results. I have used the method a very little and cannot say that my experience was such as to lead me to advocate its use. It worked all right, but the results were not any better, if as good, as I was getting by other methods. It consisted in packing the work in a mixture of 1 part saltpeter to 5 parts—by weight—of granulated charcoal. It was necessary to drill vent holes in the cover of the box to prevent an explosion when the gases generated became ignited. I understand this method is used quite extensively in some large shops in Europe as well as in this country, when case-hardening large pieces of work, and had I experimented further with it I might have looked on it with greater favor. The work is quenched in the bath the same as when the other methods are used.

The Workingman's Library.

BY LUTHER G. STEBBINS.

Someone has said that "A little knowledge is a dangerous thing." Very likely there may be a sense of application in which this bit of ancient philosophy is quite true, but generally speaking the statement is an erroneous one. Even a little knowledge is a valuable and not a dangerous possession, and a man with but a little knowledge is more useful to the community at large and more valuable to his employer than is a more ignorant man. Ordinarily a man acquiring a little knowledge or learning is very apt to thirst for more, and to seek after it. It is a precept born of common experiences that the very worst sort of a neighbor is the ignorant or unlearned man. In these days of fine schools, with the vigilantly enforced compulsory education law, the woefully ignorant are decidedly in the minority, and it is well that it is so. Nearly every man has acquired a certain degree of book learning, and while a man's usefulness in the world is not to be gaged entirely by this acquired knowledge, yet it is true that the educated men are the ones who have wrought the mighty work in the world's history.

When men arrive at the age when work is required of them, nearly all have acquired a good foundation upon which to build in the way of a broader knowledge of the world's work. This class of men usually thirst for more knowledge, and are always seeking an opportunity to increase the scope of their learning. Every employer, therefore, has a chance to help his men attain a larger knowledge, to acquire a greater degree of education. Some men will seek for themselves, and truly "they shall find," but there are many who need a helping hand, an encouraging word. This is the opportunity for the progressive and broad-minded employer.

Reading is a great and grand means of broadening one's knowledge, and generally speaking a well-read man means a well-educated man, as the intelligent and conscientious reader will educate himself by a diligent and careful perusal of the best books to be had. This is just where the employer has an opportunity to help many men, in that he may select and extend to his employees the use of a good collection of books whose influence and teaching will be entirely for good.

The writer has for a long time strongly urged the establishment of a reading room in every shop where it is feasible, and where this cannot be done under existing conditions the library plan here advocated is a good substitute. A first-class assortment of good books should be bought and the use of them extended to the employees. In the selection of books great care and the best judgment to be obtained should be called into consultation. The country is flooded with books of all kinds, and out of the deluge there can be selected 500 books at a cost of about $500, which will represent very well the entire lot. Man's taste in every walk of life varies with different individuals, and this is no less true in the matter of books and reading, than it is in other directions. If the employer is undecided about the class of books to buy for his Employees' Library, let him go ahead on the plan of securing the best there is in history, science, travel and fiction. With a little careful thought he will be able to get together a collection of books which will, in the main, appeal to the men and be read by them.

After buying the books they should be carefully numbered and stamped to identify them and a suitable bookcase provided, preferably located in the office. A simple set of rules should be adopted governing the circulation of the books, and a copy of these rules should be pasted in each book for the information and guidance of those who read them. A librarian should be selected from among the men themselves to have charge of the books, and he should be required to make a monthly report showing how the books are circulating and which are the most popular books of the collection. When a book is given out it should be charged up to the party drawing it, and he should return it to the librarian, leaving it in the office on a table or other place designated to receive returned books. The librarian should be allowed an hour or so before the close of the day to credit the returned books and get new ones ready for the men to be passed out as they go from work at night. It would also be well to have a small catalog printed and each man furnished with a card. The work of keeping this library in working order is not great and the expense involved not large.

It may seem to some that with a public library in every town of any size, there is small need for the employer to enter this field of educational work, but the fact is that a great many employees do not draw books from the public library who would appreciate the opportunities extended to them on the part of their employers, and after a short time will have formed the habit of reading, and reading good books, too.

It will be interesting to watch the result of the work among the men, and the employer will be enabled to see sides of their natures which would otherwise hardly be revealed.

This is the day of earnest endeavor on the part of many employers to better the condition of their men, to show their interest in their employees, and this matter of furnishing books is one of the many ramifications of the great idea of mutual helpfulness and interest in the life of the workingmen.

Distributing Illuminating Gas Under High Pressure.

On account of the heavy cost of mains when illuminating gas is distributed at ordinary pressures, especially to outlying and suburban districts of a city, plans are being matured in St. Louis for the use of higher pressures in the mains with reducing valves at the suburban distributing centers. Two systems will be used, in one of which the pressure in the mains will be about five pounds per square inch, this pressure being adopted in order to use cast-iron mains. In the high-pressure system, pressures of 20 to 80 pounds will be used with pipes having screwed joints. The machinery for the first-named system will consist of Connersville blowers connected direct to 300 horse-power Westinghouse gas engines fitted with pressure governors to adjust the speed in proportion to the demand for gas. Of the machinery for the high-pressure system, we have no information.

Foreign Markets for American Machinery.

Some little time ago I referred in these columns to the grumblings of some British engineers that, as England had abolished the sugar bounties (at a heavy cost to the British consumers), the least the West Indian sugar planters could do was to place their orders for plant with British makers of sugar manufacturing machinery. They think that, as a *quid pro quo* for abolishing the bounties, the West Indian colonies should have agreed to grant substantial preference to British sugar-making plant as against foreign manufacturers. All that sounds fairly reasonable on the face of it, but there is another aspect of the question. A big firm in Demerara write to say that American machinery has been imported into the West Indies, not only because the United States have been taking the bulk of the sugar produced there, but also for the important reason that lighter, better and more finished mills and other labor-saving appliances have been found to exist in the United States than in the United Kingdom.

I have previously pointed out that the Syrian market is worth looking after by exporters of pumps. There is in the neighborhood of Damascus a European mill installation on a fairly large scale; as one of the military turbine mills has been obliged to adopt a 25 horse-power Deutz petroleum motor for its supply of motive power, owing to the lack of water. This, by the way, is the only engine of its kind in the district. This class of machinery is quite out of the reach of the poor Syrian agriculturists and industrials. As regards pumping apparatus, there is a very good demand, especially for hand pumps for the country. Wood-working machinery finds a ready market in Damascus.

The demand for wind motors in the Damascus district is restricted, although throughout the rest of Syria there is a capital sale of these motors. A good many people here regard the introduction of new labor-saving tools and methods into Britain as having had a directly beneficial

effect upon British engineering. It is almost needless to say that practical men are agreed as to the commercial advantages of specialization in factories and of using specially designed machine tools. One of our technical journals thinks that our engineers have leaped from hopeless conservatism in the methods of conducting their business to the opposite extreme, and this has encouraged the dumping of foreign machinery more than anything else. It is thought that the time has come when more discrimination will be brought to bear; when the best in American shop procedure will be copied in British establishments, the indifferent being left alone. The opinion is further expressed that the British toolmaker "will make labor-saving tools, and can make them a great deal better than the majority of our friends across the Atlantic. We have had good opportunities of studying what we presume is considered good American practice at the new works of an up-to-date American company in Manchester. At these works there is much to be admired, and which might be copied with advantage, but there are also many 'white elephants' which we are glad to have seen, if only to know that they are to be avoided."

It is rather curious to note that invariably consuls in their reports speak disparagingly of their own countrymen in trade. Whether the consul is an American, Briton, German or Frenchman, he generally manages to draw odious comparisons against his own nationality. A while ago an energetic United States consul in England wrote that Americans were no good as merchants and exporters. Others have berated you for sending catalogs in English to France, South America, and so on. The German consuls have said much the same thing about *their* exporters, with variations; while our own English consuls are always criticising the unhappy home manufacturer, who is generally reckoned by the consul to be a poor sort of tool, with no enterprise, and only enough sense to potter along day by day. So don't be alarmed if you ever read bad things against yourselves in official and other reports. The same and worse things are also said of your rivals. The British Chamber of Commerce in Constantinople says that we (English) are the "worst merchants in the world" because some orders have gone to Germany and Belgium. But we happen to do 37 per cent. of the entire import trade there, whereas Germany—our keenest competitor—does only 3 per cent.; also, out of £790,000 worth of railway material ordered in 1902 for Egyptian railroads, no less than £549,000 was supplied from England. The Constantinople Chamber seems to be rather greedy.

American exporters should note that under the new tariff in New Zealand, American and all goods not of British make have to pay duty on a higher scale than formerly; thus:

	British.	Foreign.
Hardware	20 per cent.	30 per cent.
Pumps	20 "	30 "

Cycle parts, gas engines, oil engines, sheet, bolt and bar iron; railroad and tramway rails all have to pay 20 per cent *ad valorem*, British goods being admitted free.

London. F. C. C.

Monthly Meeting of the American Society of Mechanical Engineers.

One of the most enjoyable and profitable—to those who attended it—of the monthly meetings in this city of the American Society of Mechanical Engineers was that which occurred on the evening of January 26. John A. Brashear, of Allegheny, Pa., of world-wide fame as a maker of optical, and especially of astronomical apparatus, was announced to speak upon "The Development of Measurements," but his address might have been more correctly entitled "The Wonders of Modern Astronomy." Little was said about the details of measurement or of measuring apparatus, and practically nothing of the magnificently successful life work of the speaker himself. The lecture was not written and had more of the character of an informal talk, but in it the ability of the speaker as a popular lecturer was happily evident. He did not talk over the heads of his audience, and not a word was lost or wasted.

Mr. Brashear began by showing the practical bearing of the occult researches of the astronomer upon the operations of our daily life. He said that if locomotives could be run by the astronomers they would never be trying two or more of them to occupy the same bit of track at the same time. Steamships and sailing craft and the commerce of the nations all depend absolutely upon the astronomer. The demands of the astronomer have done more than anything else to develop the minute precision of the advanced mechanician and the instruments of the mechanician have in turn been the most potent factor in the recent rapid advances of the astronomer.

The speaker led his listeners into a consideration of some of the unimaginable distances which the astronomers are familiar with. He said that once when sitting with Grover Cleveland and Joseph Jefferson it was remarked of the latter that he was a *fixed* star, to which he replied that there are no fixed stars, and this Mr. Brashear was called to confirm, which he did, and this led to some explanation of the astronomer's way of dealing with fixed stars. It was told how the bearings and other data concerning a star are taken when the earth is at a point of its orbit nearest to the star, and similar observations are taken again when at the opposite point of its orbit, giving a distance of 186 millions of miles, and how the comparison of these data enabled the astronomer to scientifically guess the distances of half a dozen stars to be about 30 trillions of miles, while the distances of the other stars could not even be guessed at.

The various instruments at the command of the modern astronomer were successively spoken of, and the curious impression was conveyed, to at least one listener, that the telescope, while still the first necessity of the astronomer, is really doing less in the advancement of sidereal knowledge than are two or three other of the instruments employed. It must not be forgotten, however, as perhaps it might have been from what the speaker omitted to say, that those other instruments are really only adjuncts to or co-operators with the telescope and would count for little without it.

The wonders of photography were spoken of, and especially with reference to its revelations of myriads of stars otherwise undiscoverable. The spectroscope seemed to be most marvelous of all in its ability to reveal not only the constituent elements of the most distant bodies, but also their motions, and the most curious thing about the latter was that the motions revealed and made accurately measurable were not across the lines of vision, but coincident with those lines. It would be revealed with absolute certainty by the spectroscope whether the motion was toward or away from the spectator. Then the bearing of these revelations upon other lines of investigation were touched upon, such as, for instance, the constitution of the rings of Saturn. It was long ago conceded that they do not consist of solid matter, and it is now held that they are not either liquid or gaseous, but consist rather of innumerable independent bodies so closely placed that they are continually grinding against and striking off particles from each other.

The bolometer, the refractometer and the interferometer were successively spoken of and the uses of each sketched and their several revelations indicated. The speaker was a fluent man full of his subject, and it would seem to have been scarcely possible for any speaker to have put more into the time at his disposal.

At the conclusion of the lecture a large collection of lantern slides were shown related to the general subject but with insufficient time for their satisfactory explanation. Mr. Brashear also exhibited one of the gratings made by the late Professor Rowland as perhaps the highest achievement of the scientific mechanician. The evening could not have failed to be a memorable one to all present. President Swasey said that Mr. Brashear was able to be present only by serious interference with other urgent engagements.

The next monthly meeting of the society will be held on February 23, when Major Birney, of the United States Army, will tell about heavy guns.

American Enterprises in Russia.

Mr. A. H. Ford has an article in the issue of the *Iron Age* of January 28, in which he goes very much into details regarding the treatment that has been accorded the various American machinery manufacturing concerns that have been established in Russia. The story is one of repeated breaking of faith, oppression and general bad treatment. By oppressive taxes, unreasonable requirements and in every possible way apparently the Russian Government has succeeded in driving out most of the Americans that have been connected with the new works established there, and it seems likely that it will succeed in one way or another in driving out those that remain.

The story of the treatment accorded the Singer Sewing Machine Company is very impressive, the idea of this being evidently to force the company to sell at a sacrifice so that the business may be controlled by the government or by a purely Russian company.

It is stated that the locomotive works at Sormovo have now no Americans connected with them and that they are being operated solely by Russians. It is related also that measures inimical to the interests of the American owners of the Westinghouse and American Air-Brake Companies have been taken, and it seems to be clearly shown that it is the intention not to allow Americans or in fact any foreigners to remain in control of industrial establishments there longer than is absolutely necessary.

Those who have given some attention to the situation in Russia will not be very much surprised at this story. Certainly there were Americans and others in Russia at least six years ago who expected that eventually some such result as this would be brought about in one way or another, though at that time not much could be said about it because there was no tangible evidence. It was, as one might say, only an "intelligent anticipation."

The fact is, however, that this is only a little bolder exhibition than usual of a feeling which prevails more or less, we think, in nearly every country, England and America being probably more free from it than any other countries. In Germany, for instance, something which is more or less comparable with what has occurred in Russia has taken place, it being a familiar fact that some of the industries there which at first had a number of Americans connected with them have now none, or practically none. This, however, is not by reason of any governmental action as it has been in Russia, nor is it the result of a predetermined course at all, but of a natural development or evolution; there being in human nature everywhere that which makes a man rather resent being bossed by a foreigner. We see manifestations of that spirit in America more or less, many American mechanics being discoverable who will not work for what they call a "Dutch boss," and *vice versa*, the result being that usually an American machine shop in the hands of Germans and under their supervision is manned mainly by men of the same nationality, who understand each other and whose ways are adapted to each other in such a way that things can go smoothly to an extent not practicable usually where men of various nationalities work together.

It happens that at the same time that Mr. Ford's article is published there reaches us a copy of the *Yorkshire Post*, which has an article giving an account of advice given by the late Herbert Spencer to a prominent Japanese statesman who was a friend of Spencer's. This advice now published for the first time is as follows:

"The Japanese policy should be that of keeping Americans and Europeans as much as possible at arm's length. . . . You should take every precaution to give as little foothold as possible to foreigners. . . . There should be not only a prohibition of foreign persons to hold property in land, but also a refusal to give them leases, and a permission only to reside as annual tenants. Decidedly prohibit to foreigners the working of the mines owned or worked by government. . . . Keep the coasting trade in your own hands, and forbid foreigners to engage in it. . . . The intermarriage of foreigners and Japanese should be positively forbidden. There is abundant proof, alike furnished by the intermarriages of human races and by the interbreeding of animals, that when the varieties mingled diverge beyond a certain slight degree the result is inevitably a bad one in the long run.

"It seems to me that the only forms of intercourse which you may with advantage permit are those which are indispensable for the exchange of commodities—importation and exportation of physical and mental products. No further privileges should be allowed to people of other races, and especially to people of the more powerful races, than is absolutely needful for the achievement of these ends. Apparently you are proposing by revision of the treaty with the powers of Europe and America 'to open the whole empire to foreigners and foreign capital.' I regret this as a fatal policy. If you wish to see what is likely to happen, study the history of India. Once let the more powerful races gain a *point d'appui* and there will inevitably in the course of time grow up an aggressive policy which will lead to collisions with the Japanese; these collisions will be represented as attacks by the Japanese which must be resented, as the case may be; a portion of territory will be seized and required to be made over as a foreign settlement; and from this there will grow eventually subjugation of the entire Japanese Empire."

No matter how much one may believe in the common brotherhood of man and in equality of rights, it is nevertheless true that there is a good deal of force in this advice of Herbert Spencer's, and it is not at all unlikely that the Japanese will see the day when they will wish that they had strictly followed it. It is all right for nations to arrange for the free interchange of those things which are of mutual benefit, but for a nation to allow its lands or its industries to fall into the hands of foreign peoples is not wise and is shown to be unwise by the history of every nation so far as we know. The unwisdom of this does not, however, of course justify the enticement of foreigners into a country to invest their capital and devote their time and skill to the development of industries which are then to be practically taken away from them without adequate compensation, and the lesson to be taken from the Russian experience seems to be that it is a pretty good plan to remain at home and be content to sell in foreign lands all that can be sold there and for which the money can be collected.

The American Society of Heating and Ventilating Engineers on the Metric System.

The American Society of Heating and Ventilating Engineers voted recently upon questions connected with the proposal to advance the introduction of the metric system. As given in *Engineering News*, the result of the vote was as follows:

Voting membership	168
Average votes cast	80
In favor of the adoption of the metric system of weights and measures as the legal standard of the United States	34
Against	45
In favor of adoption of metric system in departments of Federal Government	37
Against	42
In favor of legislation which would promote the adoption of the metric system	41
Against	39

It would be interesting to know what kind of a law would be favored by those who voted against the adoption of the present proposed law and in favor of "legislation which would promote the adoption of the metric system." The proposed law would undoubtedly "promote" such adoption, and it would do it by making whatever of increased expense might be thereby incurred fall upon the National Government as the purchaser of things made under that system—if there were any measurable increase. Do these voters hope for a law that will "promote" and that will do it with less chance of injury to any private interest than this will?

An exhibition of motor-driven boats will be held at the Herald Square Exhibition Hall in New York, February 8 to 20, inclusive. It is expected that a very great variety of the smaller power-driven boats will be exhibited.

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Scraping That Would Pay But Will Not be Done.

A well-known engineer, whose early education was received in the shop, was in a reminiscent mood the other day, and said that during a period of about six years he was absolute "monarch of all he surveyed," so far as the shop was concerned. Whatever he said "went," and during that period in the department of which he had charge, and where a good deal of very fine punch work was done with compound dies, he had the bed of an inclined punch press carefully scraped to a surface plate and the bottom of the bolster plate scraped to fit it. This bolster was held to the bed of the press by extra large bolts having case-hardened threads, and under the heads of the bolts and under the nuts were washers so arranged as to form universal joints and prevent any cramping or uneven distribution of pressure. There were other presses in the room precisely like this one, except for the above mentioned features, and our friend declared that the dies used in the press which had been treated in this manner uniformly lasted from four to five times as long as they would last in any other similar press doing similar work. The reason for this, he declared, was that with a very moderate tightening of the bolster bolts—in fact, such tightening as could easily be done by turning the nuts down by hand—the dies remained in absolute adjustment until they were purposely moved, whereas in the other presses there was a constant creeping of the bolster plate, due, he thought, to the vertical springing of the parts or the transference of the pressure from one part of the plate to another during the punching stroke, and which resulted in the die constantly getting out of adjustment with reference to the punch, and therefore, of course, being impaired rapidly. This man was thoroughly convinced that it paid, and paid well, to fit up that punch press in that manner; yet he never fitted more than the one machine, and declared that he probably never would so fit another, unless it were in a shop that belonged absolutely and entirely to himself.

There are things that would certainly pay in the end that it will, nevertheless, not pay the mechanic to do, because the actual money returns on them may be either so much obscured by other things, or may be stretched out over such a period of time as to greatly attenuate them, and all the while the man who handles the treasure box keeps his eye on that extraordinary expenditure, and the chances are that by the mutations of shop life, a new mechanical man will come who will utterly fail to understand or appreciate what has been done that is unusual or outside his own experience, and will condemn all of it.

We have the word of an experienced, successful and highly skilled man who has tried this plan, and who certifies that it pays. It is extremely doubtful if there is a single other mechanic who will be convinced that it would pay, and who at the same time will be allowed to adopt it, or would think it advisable to propose it. There are many things that one may believe to be both mechanically and pecuniarily justifiable and right, yet which are not likely to be adopted. But what is the use in spending good money to secure a very stiff punch press—one that will not spring—if, after it is gotten, the bolster that holds the dies is roughly planed and placed upon a roughly planed seat, neither of which are true planes nor fit each other, and which allow the bolster to spring more or less at every stroke? It is pretty certain that it would pay the users of machines generally if a lot of scraping were done about them that no one now thinks of doing, and if it was charged for in the price. We believe that planer housings, for instance, should be fitted to the bed by scraping and that planer buyers ought to be glad to pay the cost of doing it. But not many of them would. The same is probably true of the set-over slide of lathe footstocks and many other parts of machine tools which are held together by bolts, and which it is important shall be as solid and free from vibration as possible.

Standard Size Catalogs.

Last week out of sixteen catalogs which we published notices of, nine (or 53 per cent.) were given as standard, 6x9 inches, which is very encouraging for those who believe in and have advocated the use of standard sizes, and indicates that eventually practically all catalogs in machinery lines will be of this size, which is the size of all the publications issued by the various engineering societies.

The Union Engineering Building.

We have already referred to the discussion that took place at the recent meeting of the American Society of Civil Engineers anent the proposed union engineering building. From the published reports of the discussion we take the following remarks by Mr. Samuel Whinery, which, it seems to us, are saturated with common sense, and ought to be carefully considered by those who oppose the union building project. Mr. Whinery said:

"In the first place, there seems to be a general mistaken idea as to what this whole measure involves. It has been stated distinctly that it does not involve a merger of the societies, nor a merger of their finances, but it seems necessary to go further and inquire what it does mean. As I understand the whole proposition, and I do not wish to be understood here as speaking in favor of the measure or against it at the present time, but merely this particular point, that is involved—as I understand it, is this: It is proposed that the societies jointly invest in a certain tract of land for the purpose of erecting a building thereon for the joint occupation of the several societies. It is not proposed

that the investment in that land shall be a partnership affair at all. It is to be held by a separate corporation, separate and distinct entirely from any of the societies and from all of them. That corporation is to be made up from representatives from each of these bodies. Now, this corporation will ask each society to purchase and be responsible for a certain amount of bonds, or its share of bonds, to be issued for this property; just the land for it, on which the building is to be erected. This society purchases and holds one-fourth or one-fifth, whatever it may be, of the amount of bonds issued to pay for that property and will have those bonds as property, and should they become worthless we lose the amount. That is all there is in that. Each society is asked to go into this building which it is proposed to erect without any cost to the society and to pay its share of the operating expenses of the building, nothing more. This corporation that it is proposed to have to hold this property and administer it, can assess certain rentals, certain expenses of management of the building against each society. They can do nothing further than that. I see no merger in that whatever. I do not see any partnership in it, and I do not see even any entrance of this society as a society into a corporation in which it is directly a member. I think it is important that the responsibility that this society shall actually assume be carefully separated from the burden which it seems to be the impression here the society is to assume. We do not assume responsibilities for this vast enterprise. We assume responsibility for only certain things in it. Now I do not see under these circumstances what benefit it would be to this society whatever to know the exact financial status of each sister society or what its standing for membership is to be. We are not uniting with them. The management of this society, if this measure is adopted, will be just as independent of any of the other societies as it is to-day, absolutely. The other societies obtain no rights in the management of this society by this proposed donation, and this society obtains no rights in the management of the other societies. Now, where are we interested in this matter of the financial standing of these societies or their standing in membership? If it was merely a question whether we should jointly occupy that building with a law firm I could see no objection to it whatever. I do not think the fact that this society, together with a law firm, or a medical association, or a single doctor, may agree together for their mutual benefit to rent a society house and use it jointly would in any way disparage this society. It is merely a question of the joint occupation for the common benefit of all, and it seems to me that we are going entirely too far, entirely further than is necessary, and certainly further than is courteous for this society to undertake, to inquire into the standard of membership or financial condition of its sister societies."

Some New Things.

THE ROCKWELL ROTARY FURNACE.

The furnace is here shown is of a novel type with advantages peculiar to itself. It is in fact two furnaces which are used alternately, the melting thus being practically continuous in one or the other. The half-tone, Fig. 1, shows the exterior and Fig. 2 the interior of the furnace. No crucibles are used, the furnace chambers being lined with refractory material which is inexpensive and cheaply applied, and the charges of metal to be melted being placed right in the chamber, as in the right-hand chamber in Fig. 2. The fuel used is oil or gas, the air being supplied by an ordinary fan or pressure blower and there being a burner at each outer trunnion. But one of these burners is normally in operation at a time, the flame which is melting one charge extending into the other chamber and giving up much of its remaining heat to the fresher charge of metal. When the charge in either chamber is completely melted it is passed out by turning the chamber and bringing the mouth down to the pouring position as in Fig. 3. The two chambers may be used for different metals or for the same metal, and both charges may be melted so as to be poured together if a large quantity of metal is required at once. The halves of the chambers are hinged so as to make the entire interior perfectly accessible for relining or for any purpose. The furnace is made in four sizes, with capacities from 350 to

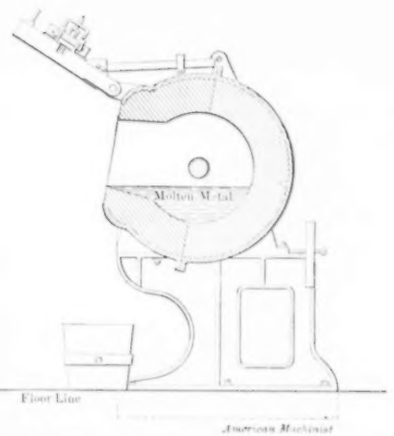


FIG. 3. TURNING THE CHAMBER FOR POURING.

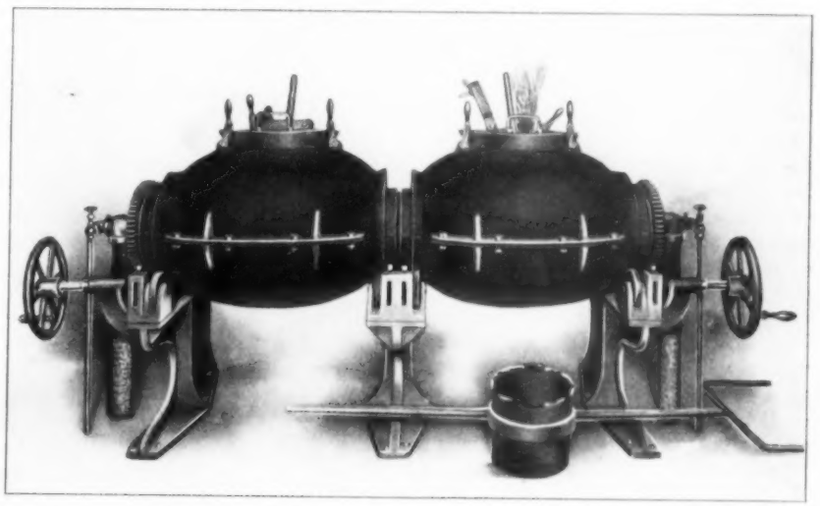


FIG. 1. THE ROCKWELL ROTARY FURNACE.

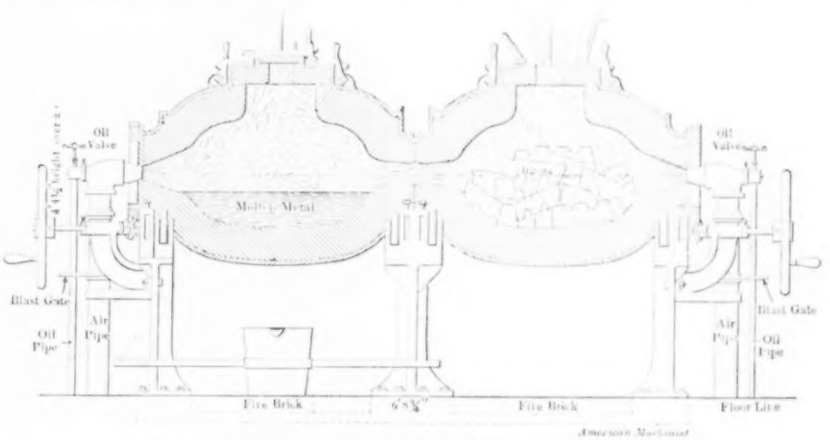
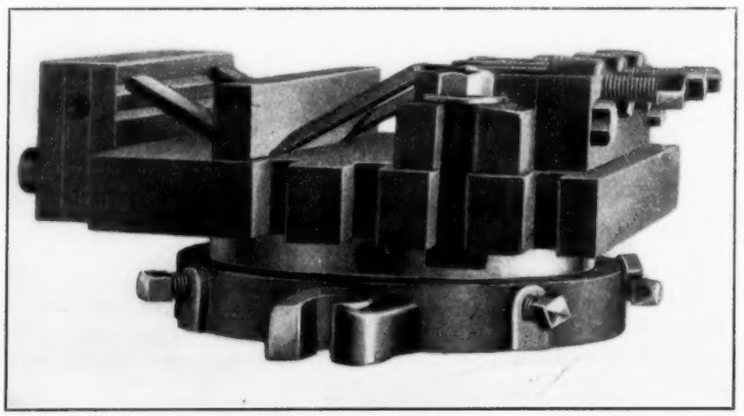


FIG. 2. VERTICAL SECTION OF ROCKWELL ROTARY FURNACE.

3,000 pounds for each chamber, by the Rockwell Engineering Company, 26 Cortlandt street, New York city.

WORK HOLDER.

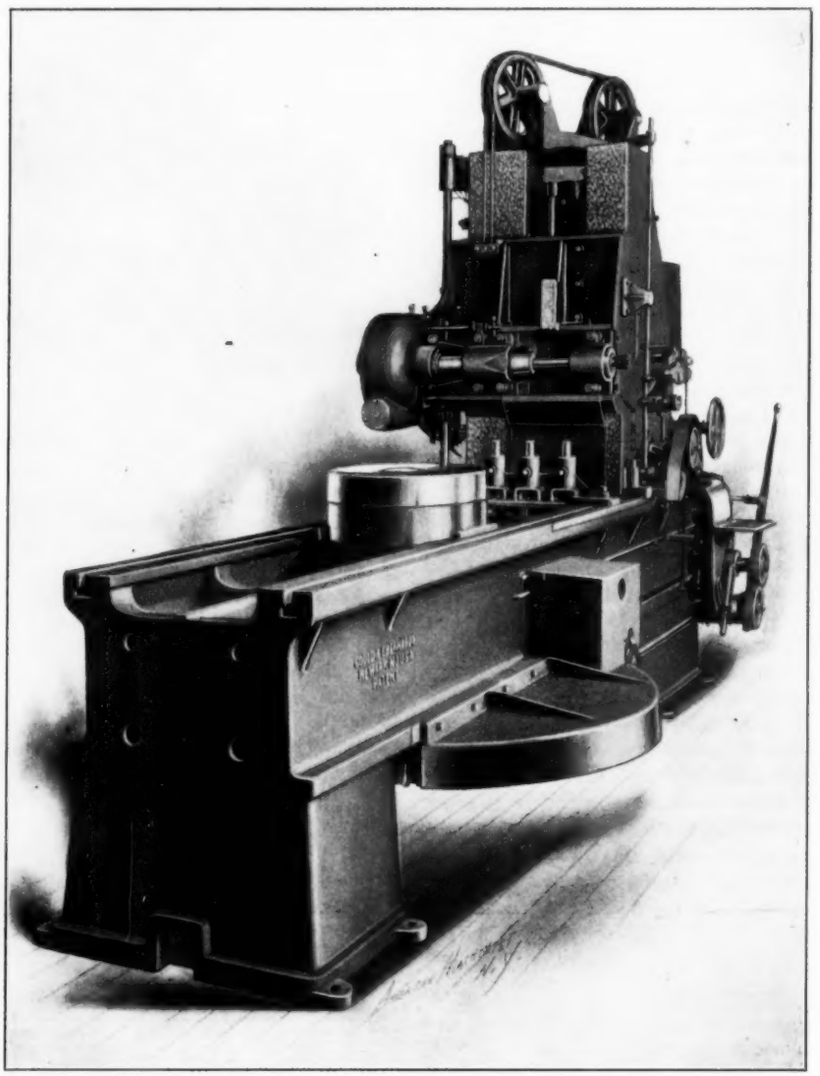
This is a special form of vise suitable for the milling machine, shaper or planer. It may be swiveled to any angle, and will hold work of almost any outline. The chief peculiarity is that the piece corresponding to the sliding jaw in the ordinary vise is here provided with several steel cross pieces dovetailed in place, and adjusted by set-screws, these steel slides as well as the fixed jaw having horizontal grooves planed across, as shown, to engage the ends of steel fingers for holding down the work. All shop men with experience in planer work will appreciate this method of holding the piece. As the block carrying the slides and set-screws may be moved around to any angle on the vise body and clamped, taper work may be held as readily as straight. It is obvious that with the individual clamping slides and fingers as many pieces as there are slides may be securely held at the same time, even though all are of different dimensions. A tapped hole is provided at each end of the fixed jaw so that a pair of stop plates or clamps may be attached, and between these plates a number of thin, short pieces of the same width may be held square while the upper ends of all are being dressed off in one setting. The vise is made in three sizes—5½, 7½ and 10 inches—by the New England Machine Company, Pawtucket, R. I.



WORK HOLDER.

LARGE AUTOMATIC GEAR-CUTTING MACHINE.

The half-tone illustrates what is said to be the largest entirely automatic gear cutter ever built, it cutting spur gears only—by means of a rotary cutter—up to 12 feet in diameter, 24 inches face and 4½ inches circular pitch. There have been larger machines built for this purpose, but such have been semi-automatic, while the machine shown, after once being set and started, needs no further attention until the gear blank is completed. While differing in detail and construction from the smaller new type machine of the same builders (Gould & Eberhardt, of Newark, N. J.) the principles are essentially the same in so far as operation is concerned. The machine, being designed for heavy work, is arranged so that the gear blank will lie flat and be rigidly supported direct from the ways of the bed, the cutter slide, which has a quick return, working up and down on the face of a column which is movable longitudinally on the bed either by power or by hand. The bearing for the work spindle carrying the arbor and dividing wheel is formed in the bed itself, and the positioning of the cutter in relation to the gear blank is obtained by moving the upright or column. Its exact movement to a fixed distance is secured by means of a graduated dial and scale, with a stop which can be set at any predetermined point. The cutter slide has a long, flat bearing on the guide, and the bearings for the cutter spindle are of substantial proportions. The cutter slide is counterbalanced by a 3,000-pound weight held by two wire cables, as represented. The cutter spindle is driven by worm and worm wheel, and in addition to the regular spindle for the large diameter, coarse-pitch cutters, an auxiliary spindle is furnished for cutters up to 1 diametral pitch. The worm dividing wheel, which is of large diameter, as indicated, is made in halves, as in the smaller gear cutter, and is covered with a guard, to keep out all chips and dirt. The chips produced by the cutter, and the lubricant for keeping the cutter cool drop into a compartment in the base from which the chips can be readily



LARGE AUTOMATIC GEAR-CUTTING MACHINE.

removed, the lubricant flowing into a pocket below, from which it is again pumped to the cutter. While divisions for the different numbers of teeth are regularly made automatically through combinations of change gears, the machine is so arranged that it can be operated semi-automatically, and the dividing mechanism tripped by hand for each tooth, if desired. One belt, on pulleys at the rear, drives the entire machine through splined shafting and gearing, and no movement can take place unless previous movements have been fully completed. A very essential feature of this construction provides that unless the division of the worm wheel is made complete, the cutter carriage cannot possibly feed forward. This movement always takes place automatically, and requires no adjustment whatever, for any size of gear. In a test made of a 10-foot gear cut in the machine, the greatest error discovered between any of the teeth was 0.0015 inch. This machine weighs 40,000 pounds, and was built for R. D. Nuttall Company, Pittsburgh, Pa.

THE "STAR" SPEED LATHE.

The spindle of this lathe is forged from crucible steel, carries a four-step cone pulley machined inside as well as out and thoroughly balanced, has a hole bored through from end to end, and runs in dust proof and self-oiling boxes of phosphor bronze, each bearing being provided with do ble sets of wicks for supplying lubricant from an oil well below. The footstock is of the cut-under pattern; it is

THE "STAR" SPEED LATHE.

locked to the bed by the lever in front. Its spindle has a combination screw and lever motion, and under the hub of the lever is a dial graduated in sixteenths and useful when drilling, counterboring, etc., to a required depth. The dial is adjustable about its spindle, and may be readily set and clamped at any point. To change from screw to lever motion, it is only necessary to loosen a thumb-screw releasing the spindle sleeve. The long hand lever can be lifted off when not in use. The hand rest is provided with long and short T-rests; the rest socket and saddle are clamped to the bed by a cam locking device and the T-rest is held in its socket by a friction clamp, both clamping devices being operated by levers secured at the front, as shown. The bed has one flat way and one V, and at the back is attached a convenient shelf for the reception of tools, etc. The lathe is equipped with face-plate and centers, and, if desired, with slide rest, draw-in chuck, etc. The countershaft furnished has self-oiling and self-alining boxes, and is fitted with tight and loose pulleys, or, if required, with friction pulleys. The lathe is built in two sizes—10 and 12 inches swing—by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.

Personal.

E. B. Swinden, of Swinden & Acosta y Lara, Montevideo, Uruguay, intends to visit the United States on business in April, remaining about three months, and he suggests that if catalogs., etc., are forwarded to him before his departure the study of them will be mutually advantageous and time-saving.

Wm. H. Brenner, an engineer who was formerly in N w York but has been in Japan for sixteen years past, has been visiting here and has returned to Yokohama, where he now has a machine shop and builds tools and does contract work. He says that after a man has lived for a time in Japan he is apt to acquire the habit of it and to want to remain there.

Obituary.

William Reisinger, the "village blacksmith" of York, Pa., who had been in business sixty years, died January 25.

William Gordon, thought to be the oldest locomotive engineer in the country, died at East Millstone, N. J., January 26, eighty-two years old. He ran an engine on the Pennsylvania Railroad for fifty-six consecutive years.

William A. Sweet, a well-known steel manufacturer of Syracuse, N. Y., died at his home in tha' city on January 30. Mr. Sweet was born in the town of Pompey, in the same county, October 12, 1830, and at the age of eighteen he went to learn the edge-tool business at $40 a year. He later was blacksmith-machinist and carried on the gun business. In 1868 he started with his brothers, Aaron A., John E. and a brother-in-law, C. C. Bates, as machinists and manufacturers. John E. and Mr. Bates withdrawing from the firm, the remaining brother and the eminent William B. Cogswell began the manufacture of cutting apparatus for mowing and reaping machines. Mr. Cogswell selling his interest to George Barnes, the firm name became Sweet, Barnes & Co., and the making of their own steel was started and drifted into the making of tool steel and steel goods. This company was dissolved, Mr. Sweet taking the steel business and the other partners holding to the knife business, which became George Barnes & Co. and later The Whitman & Barnes Company. The steel branch was Wm. A. Sweet & Co. Mr. Sweet conceived the idea of utilizing the crop ends from the Bessemer rails, large quantities of which were accumulating around the Bessemer plants, the idea being to simply split the rail into three parts, bottom, web and head, and to rolling and hammering these into bar stock. The bottoms at first went into bars and rods for mowing machines, wagon tires, sleigh shoes, etc. The webs were converted and rolled into spring steel and made into mowing machine springs, the rail heads being hammered into crow-bars, probably the first steel bars put upon the market. As the Bessemer steel makers became more expert and careful, the crop ends grew shorter and shorter, until anything over a foot in length had to be accepted. The question as to where the stock was to come from was soon settled, as the ships began to bring over from England their worn-out rails. These were broken into available lengths and then worked up as had been the practice with the crop ends. Receiving crop ends and old rails from different makers, Mr. Sweet discovered a vast difference in the quality, and here he utilized the knowledge he had gained in his early training. He began to finish the bars at a low red heat, and this has been the practice at his works now for fully thirty years. An element in Mr. Sweet's character is well shown by an incident which occurred in the beginning of the splitting of the rails, which was done by a specially prepared pair of rolls. It took about all the money he could scrape up to pay for the first pair of these rolls. When everything was ready the train was started up, he put in the crop end and when it had gone about half way through one of the rolls broke in two. Instead of looking upon this as a dead failure he said, "It split it half through," and in his emphatic and not over-elegant manner he said, "I will make them split a whole one!" His heating furnaces have for at least thirty-five years been fed by automatic stokers of his own invention; he also invented many of the devices used in his business. Mr. Sweet was at various times interested in other industries and in city affairs, but his place in life was that of a steel worker. Mr. Sweet was an elder brother of Prof. John E. Sweet.

At the hearing of the House Committee on Coinage, Weights and Measures held January 28, protests against the metric system bill were made by Mr. H. H. Suplee, of the *Engineering Magazine*, and by Mr. E. F. Du Brul, commissioner of the National Metal Trades Association. Mr. Du Brul's protest was official and was the outgrowth of an adverse vote by his association.

What is said to be the largest loom in the world has been built in Germany for weaving artists' painting cloth. It is capable of weaving feltings 48 feet wide.

Commercial Review.

NEW YORK, Monday, Feb. 1, 1904.

The developments in the machinery market for January, showed that the outlook for business was better than at the conclusion of the month which preceded it. From the standpoint of inquiries, the month was especially good, these being larger in point of volume, and embracing more departments of the trade than could be said for December.

The business closed was entirely confined to small lots, but these made a pretty fair showing in the aggregate. Machinery men are very partial to this kind of trade, saying that less difficulty is experienced in closing it, and better prices are obtained than when they have large propositions to deal with. Some of the latter on which the attention of machine-tool men have been centered recently, are still in abeyance, but every week that passes brings them nearer to closing than the one which preceded it.

Electrical machinery manufacturers are very well pleased with the way the new year has opened for them. One of the reasons for this is the marked activity shown by municipalities in going ahead with enterprises requiring electrical machinery. Small municipalities especially, are installing electric-light systems on quite an extensive scale, the impetus being furnished by the easy money market enabling them to float securities more quickly. For motor-driven tools, the demand has quickened a little also.

In the matter of prices, values are being well maintained. Machinery men assert that they hear nothing nowadays about any purchases being delayed on the belief that lower prices are possible, although admitting that talk of this kind was plentiful before the National Machine Tool Builders' Association put itself decisively on record against any reduction of prices. Not without some interest in this connection is the fact that recently there have been meetings of manufacturers of carriage and machine bolts, hot pressed and cold punched nuts, and of hatchets and adzes, and existing prices were reaffirmed by them all.

The pig-iron situation, for the time being, is rendered interesting by the fact that Northern furnaces are booking the most of the tonnage that is being placed. Up to the advent of the present year, and for a period covering at least six months prior to it, Southern furnaces occupied this distinction. The change about has been occasioned by Northern furnaces getting the benefit of cheaper coke and limestone, as well as reduced freight rates.

During the time that the Southern furnaces were mohopolizing the pig-iron market, they could offer their product at from $1 to $2 per ton cheaper delivered than their Northern competitors. But because of the lower costs we have stated, Northern furnaces are now able to undersell Southern ones. Freights have considerable to do with this condition of affairs. The freight from Birmingham to New York, for example, is $3.75 per ton, and Southern interests find this a heavy handicap in trying to secure business in Northern markets. This is especially true of New England and Northern New York points, where the freights are prohibitive for them, so far as meeting the prices Northern companies are asking at their furnaces.

Of more than ordinary interest is the attempt that is now being made to consolidate the three leading Southern furnaces, as the best method of putting a stop to the ruinous competition that has been going on for some time among them, since all previous attempts to prevent this have proven futile. Good judges in the iron trade say it is the only way out of the difficulty, but think it will take months to effect it. Some have no faith in the negotiations with that end in view.

The policy which most consumers of pig iron are pursuing nowadays is in buying only when they need supplies for immediate use. All attempts to get them to purchase for extended delivery have failed. In fact, this method of buying seems a thing of the past.

So far as the export machinery trade as a whole goes, the month showed some good results. When one gets down to details, however, and discusses the machine-tool aspect of it, for example, reports vary. The majority of houses, however, say their export order list is gradually growing larger.

CHICAGO MACHINERY MARKET.

Western power people are interested in a comparison which is about to be made between a Corliss engine and a turbine of 1,500 horse-power each under like conditions at Connellsville, Pa. It is reported that considerable business in the West is being delayed until the relative merits of the two are more clearly established. However, there has been a brisk trade in Corliss engines during the past month. The Allis-Chalmers Company has sold ten engines during the month of more than 3,000 horse-power each, while their sales of engines of lighter power have been much more numerous than for months past. Two of the smaller engines sold were to the St. Louis and suburban road, one horizontal cross-compound of 2,000 horse-power and one single cylinder of 1,500 horse-power.

There are perhaps at present fewer inquiries for large units of power in the West than in the East, at least that statement is made by manufacturers who have representatives in both parts of the country. But the inquiry for both boilers and engines in the West was for January far greater than for any month since last summer. There is a certain slowness in the closing of these inquiries, but the earnestness and genuineness of the inquiries is generally acknowledged. Possibly one reason for this is that earlier deliveries can now be made than during most of last year, so that haste in the closing of contracts is unnecessary. The improvement in the demand for power is regarded by some makers as peculiarly timely, on account of the house cleaning that has been in progress in their order books. There is a more decided aggressiveness in many sales departments, and it is perhaps for this reason that circumspection is observed in the giving of publicity of orders placed, a tendency that is quite noticeable.

But authorities agree that the general conditions of business continue to improve. This is made apparent from the fact that the more palpable inquiry for power comes from no particular source but pervades all classes of buyers, including electric railways, and manufactories of all kinds. And the amount of business that has been deferred and that is now hovering indistinctively in the future is considerable.

The representative of a large boiler manufacturing company within the past few days wrote inquiries to about thirty people who had last summer been in correspondence with him in regard to the purchase of equipment, but from whom he had heard nothing after he had named them prices. He had expected to find that at least 50 per cent. of the number had closed with his competitors. He was more than surprised to learn that of the thirty only one had bought and he for only part of his requirements. Many of these laggards said they would be in the market soon. They had delayed because of an expected falling market and for various other reasons.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 144.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Stamping Dies. Emmons Collins, Chicago.

Stamping dies and tools designed for rapid work. Box 73, Racine Jct., Wis.

J. Gregory, 140 W. 23d st., New York, specialist in small machine designing.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Machine and brass works want a specialty to manufacture. Address R. J., care AM. M.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

We will buy, pay royalty or manufacture for patentee a patent possessing merit. Box 111, AMERICAN MACHINIST.

Special machinery for reducing labor and increasing profits, designed and perfected. C. E. Sargent, M. E., 1214 Manhattan, Chicago.

A complete course in mechanical drawing is given in Rogers' "Drawing and Design." 83. Illustrated catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

Wanted—Medium weight and heavy machinery to manufacture, by large modern machine shop and foundry employing up-to-date methods. Address Box 87, AMER. MACH.

Wanted—Specialties, automobile parts, or contract work by a first-class, modern machine shop having brass and iron foundries in connection. Address Box 39, AMER. MACH.

Wanted—South American agency; reliable party, resident in South America, desires to represent or act as selling agent for manufacturing or export firms. Address A. M., 122 Front st., New York.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

Designing of detail parts for small machinery and experimental apparatus, drawings and specifications, examination and reports on inventions for investors. C. E. Whitney, 123 Liberty st., New York.

Machinists will find in Rogers' Machinists' Library (3 vols., $7, payable $1 monthly) the most helpful set of home study and reference works. Illustrated machinists' catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

Organization of entire shops or special departments; costs of production fixed and reduced; piece, etc., prices fixed on rational basis; advice on equipment, machine shops, foundries, etc. H. Hess, P. O. Box 84, Yeadon, Pa.

Want to furnish men of proved ability, as managers, superintendents or foremen, in the metal-working industries; no charge; also want men to fill such positions. For terms address James Brady, Room J, 20th Floor, 220 Broadway, N. Y. City.

Notice—A self-starting and reversible gasoline engine with valuable patented improvements, used for marine and stationary; I am looking for capitalist or machine to manufacture; write for full particulars and photos. Box 123, AMERICAN MACHINIST.

Who furnishes apparatus to remove the ashes out of the flues of double boilers, each consisting of two Cornwall boilers, arranged one on top of the other, with two fires in each lower boiler? The working order of the shop does not allow to wait with the cleaning of the flues until the brickwork and the boilers are cooled down, and therefore an arrangement is necessary with which the cleaning can be done without sending a man into the flue pipes. The construction of the brickwork does not allow to sweep or run the ashes straight through the flues. Address Box 105, AMERICAN MACHINIST.

Wanted—Machinist possessed of thorough practical and technical knowledge automatic and Corliss engines, to assume entire control mechanical departments general foundry and machine business making a specialty of engine and pump repairs approximating $200,000 per year; one who can invest $5,000 to $25,000; must be active and able to produce rapidly; only such as can furnish unquestioned references will be considered; to such will furnish every facility for determining earnings, condition, etc., of advertiser. Address fully, stating age, experience, salary, etc., "General," care AMERICAN MACHINIST.

For Sale.

For Sale—Patent, new machine tool, a necessity in every shop, mill and factory. Address Box 62, AMERICAN MACHINIST.

For Sale—Four complete sets of patterns with all drawings for large machine tools; will be pleased to correspond with parties wishing to take up a good line. Box 112, AMERICAN MACHINIST.

Drawings of two-cycle stationary and marine gasoline engine, 1½, 2½, 3, 4, 6, 8 and 12 H.-P.; our latest design; one set only will be sold East. For particulars address Duluth Gas Engine Works, Duluth, Minn.

For Sale—A machine shop in New York city (Manhattan); suitable for special machine building, automobile and general repair work. Established three years. Fully equipped with modern tools, all in first-class shape. Good location. Address R. C. Handloser, M. E., 127 Duane st., New York.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.; foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Experienced wood pattern maker, American, wishes position; small town preferred. Address BOX 85, AMERICAN MACHINIST.

Draftsman, technical graduate, now in brass mill, 4 years' experience, mill work and machine design, wants position; New England or Middle States. E. Eisenwinter, Waterbury, Conn.

Mechanical and electrical engineer; Swedish technical graduate; 10 years' experience; specialist in the manufacture of electric cables and cable machinery; has been superintendent and designer with large concerns in Germany, Russia, Austria and United States. Address B. L., care AMER. MACH.

DELAWARE.

Young man, 11 years' shop experience, now has charge and designs tools, good education, reliable, up-to-date, wants position; $100 a month. Box 113, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes to change. Address Box 104, AMERICAN MACHINIST.

Wanted—Position of responsibility, by young man; 13 years' shop and drafting-room experience; up to date on appliances for turning out work rapidly; understands handling men. Box 536, AMER. MACHINIST.

Expert on gearing wants position, general foreman or assistant; have 9 years' practical experience in gear cutting; at present foreman in gear-cutting department with a large concern; desires to make change first of February. Box 117, AMERICAN MACHINIST.

NEW JERSEY.

First-class millwright and carpenter wants steady position. Box 126, AMER. MACHINIST.

Experienced draftsman and designer desires a change; has been "chief draftsman" and at present holds responsible position. Address Box 106, AMERICAN MACHINIST.

Superintendent or assistant, by one who has had 20 years' practical, technical and drawing-room experience; is at present superintendent of a plant employing 100 men, but desires a change. Address Box 107, AM. M.

NEW YORK.

Japanese mechanical draftsman; graduate; 4 years' experience. Box 128, AM. MACH.

Mechanical draftsman, experienced, desires position. Box 121, AMERICAN MACHINIST.

Experienced operator on plain or surface grinder seeks position. Box 127, AM. MACH.

First-class draftsman wants position in office for automatic or tool work. Box 119, AMERICAN MACHINIST.

Mechanical draftsman, familiar with pattern and machinery shop, wants position as superintendent's assistant. Box 118, AM. M.

Superintendency wanted by an up-to-date man; years of experience; shop organizement of the best; would take work by contract. Box 122, AMERICAN MACHINIST.

General foreman, responsible man, progressive, expert mechanic, experienced in interchangeable, automatic and special machinery, is open for engagement. Box 125, AM. MACH.

Mechanical engineer, German, 23 years, holding diploma from German university, experienced in the manufacture and designing of pumps, armatures, oil engines, tools, jigs and general machinery, wants position as mechanical draftsman, designer or any other employment in above branches, with prospects of advancement. Box 130, AMER. MACHINIST.

OHIO.

Wanted—Position as superintendent or general foreman, by a thorough, practical mechanic, with 12 years' experience; age 38; member of A. S. M. E. Box 76, AM. MACH.

Cost department organizer and system expert desires change of position; at present in charge of a department; best of references from largest concerns. Box 129, AM. MACH.

PENNSYLVANIA.

Designer, experienced, wants position; electrical line preferred. Box 101, AM. MACH.

Expert toolmaker and all-around machinist, 14 years' experience as foreman; A1 references, desires change. Box 120, AM. MACH.

Superintendent, general foreman or chief engineer; energetic; wide experience on high-speed or Corliss engines, 100 to 8,000 horsepower; systematic, and best modern shop methods; understands Rite's inertia governor; open for engagement. Address Box 114, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

By up-to-date foreman blacksmith; understands drop forging, hardening and tempering; will be open for engagement about April 1; best of reference. Box 116, AMER. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and core-makers; we always have vacancies. Address Allis-Chalmers Co., New York Life Bldg., Chicago.

Wanted—Man of more than ordinary ability, with company engaged in the manufacture of hydraulic presses, special machinery, general machine shop work and jobbing; give age, experience, salary, etc. Address E. E. W., care AMERICAN MACHINIST.

LOUISIANA.

Wanted—An experienced salesman in the line to take charge of the small tool and supply department of a machinists' supply house; South; state age, experience and salary. Box 108, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Foreman for a machine shop; one used to gears preferred. Address "Gears," care AMERICAN MACHINIST.

Wanted—A working foreman who thoroughly understands sheet metal stamping and construction of tools for same; state age, experience and wages. Address Box 112, A. M.

NEW HAMPSHIRE.

Draftsman and designer in line of steam engines and machinery; give experience and references, age, family and pay expected. Box 86, AMERICAN MACHINIST.

Foundry chemist and metallurgist for foundry making engine and machinery castings and employing about 100 men; state experience, age and pay expected. Address Box 124, AMERICAN MACHINIST.

NEW YORK.

Canvasser to sell engine-room appliances to factories in and near New York. Box 131, AMERICAN MACHINIST.

Wanted—Experienced salesman to take a specialty being introduced to machine shops and other manufactories; may be taken as a side line. Address Box 115, AMER. MACH.

Draftsman.—First-class mechanical draftsman, familiar with steam and pumping engine work. Address M. E., Box 109, AMERICAN MACHINIST, giving age, salary expected.

Wanted—An expert toolmaker and draftsman to take charge of tool shop; must be up to date and thoroughly competent. Address Nathan Manufacturing Company, 416 E. 106th st., N. Y. City.

Wanted—A photographer familiar with machine shop methods and capable of using the best photographic apparatus for indoor work; steady employment to an expert man. Box 59, AMERICAN MACHINIST.

Wanted—An experienced designing engineer and chief draftsman, capable of taking charge of drawing office of manufacturer of steam-driven pumps and small engines; must be, or have been, in employ of first-class pump builders; all communications absolutely confidential. Address "Flywheel," care AMERICAN MACHINIST.

OHIO.

Draftsman, experienced and resourceful. M., 417 E. Columbus st., Kenton, Ohio.

Wanted—By a firm manufacturing plumbers' brass goods, a first-class toolmaker capable of designing and making tools and fixtures for turret lathes. Address, with references, wages expected, etc., The Sanitary Co., Cleveland, O.

PENNSYLVANIA.

Wanted—A first-class traveling salesman who has had experience in selling machinery for transmission of power; an active, energetic man of good character and address can make an excellent connection. Address Box 110, AMERICAN MACHINIST.

WISCONSIN.

Speed boss for machine shop doing medium and heavy work; steady position to competent man, with a bonus on work turned out; none need apply unless experienced in this line. X. Y. Z., care AMERICAN MACHINIST.

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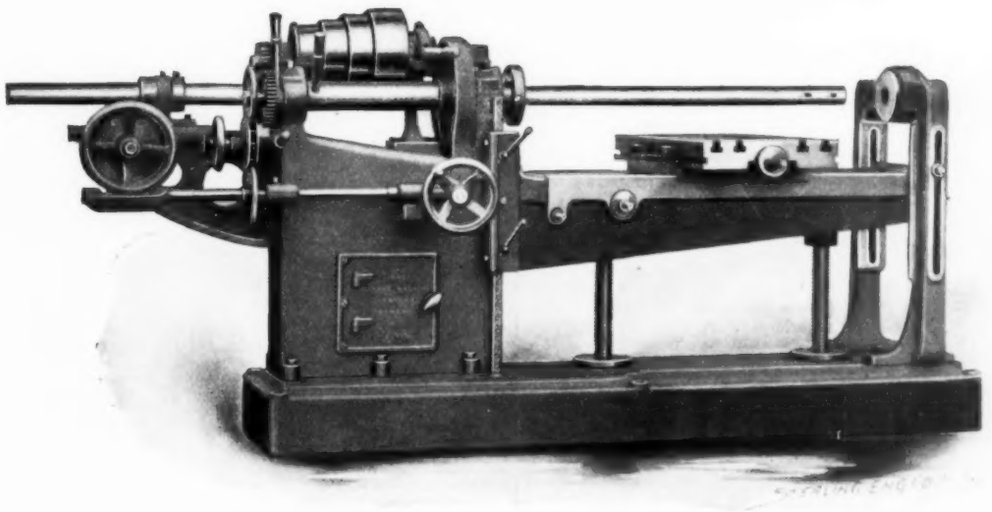

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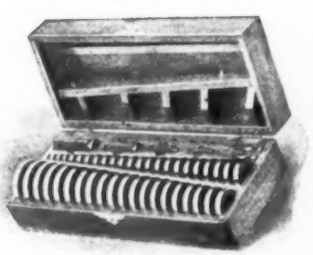

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Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Mach. Co., Rockford, Ill.
Niles-Bement-Pond Co., New York
New Haven Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Co., J. R., New York.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Greene, Tweed & Co., New York.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
Bullock Elec. Mfg. Co., Cincin., O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Cushman Elec. Co., Concord, N. H.
Eck Dynamo & Motor Works, Belleville, N. J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Elec. Co., New York.

Dynamos —*Continued*
Jantz & Leist Elec. Co., Cin., O.
Keystone Electric Co., Erie, Pa.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Bullock Elec. Mfg. Co., Cincin., O.
Commercial Electric Co., Indianapolis, Ind.
Cushman Elec. Co., Concord, N. H.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Elec. Co., New York.
Keystone Electric Co., Erie, Pa.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dresser
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich

Engines, Gas and Gasoline
Bay State Gas Engine Co., Boston, Mass.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Boston, Mass.

Engraving Machines
Gorton Mach. Co., Geo., Racine, Wis.
Roovers Mfg. Co., New York.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Export, Russian
Gradstone & Co., M., New York.

Fans, Electric
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Boston, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

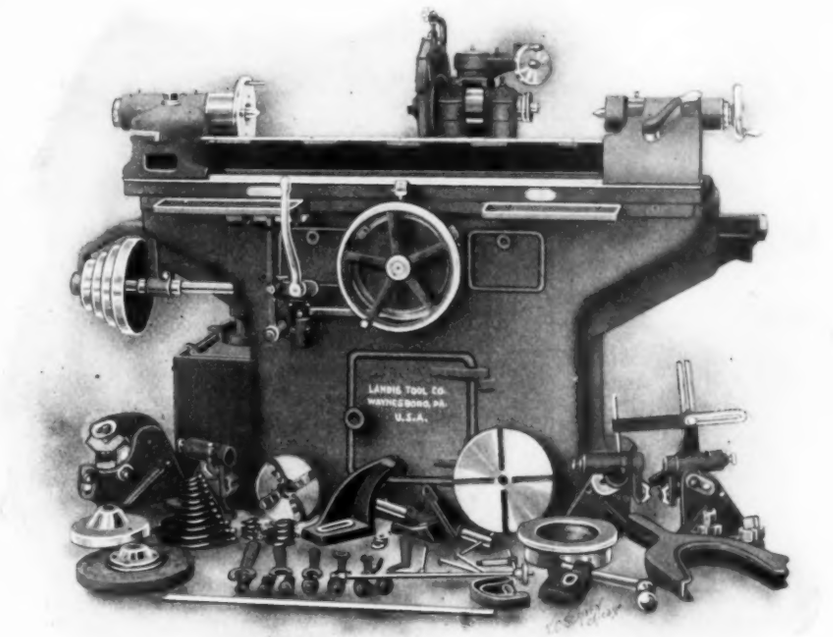
Filters, Oil
Burt Mfg. Co., Akron, O.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.
Kinsey-Burt Co., New York.

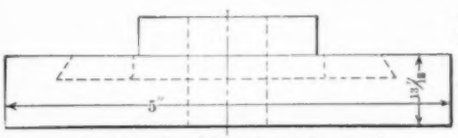
In Finishing Work By Grinding

It is more economical, finally, to be particular in your choice of grinders in the first place. The price, more or less, doesn't cut much of a figure: In any event it would not vary a great deal either way. But in the selection of the tool, you would do well to make a very exhaustive investigation of the offerings.

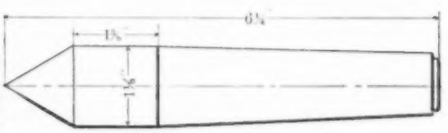
We ask you to investigate thoroughly, because the more closely you look into the Landis the more its value to you develops. In favor of the Landis stands age, experience, the determination to build well, and the further fact that they are being used where conditions necessitate the best. You can't go wrong in the installation of the Landis, but before you decide look them all over. Any inquiries will have prompt attention.



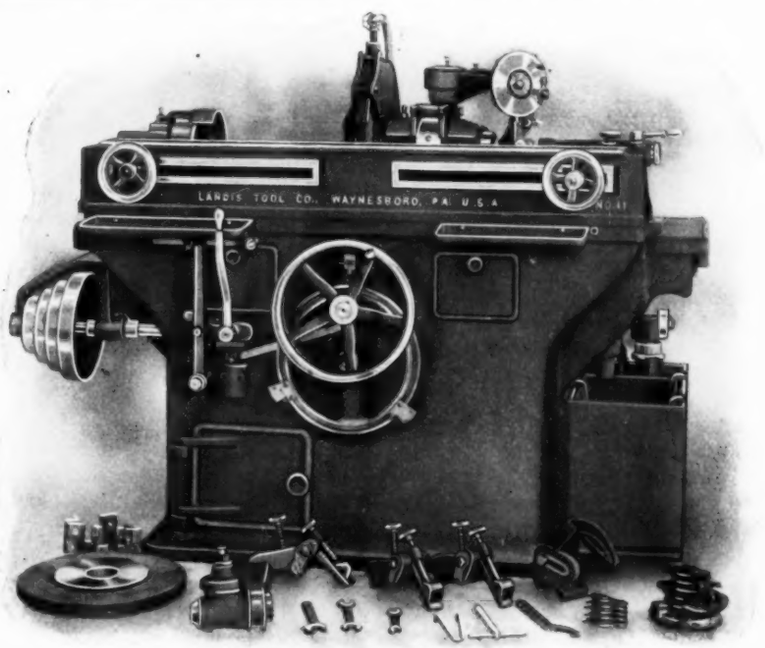
No. 3 Landis Grinder and Examples of Work.



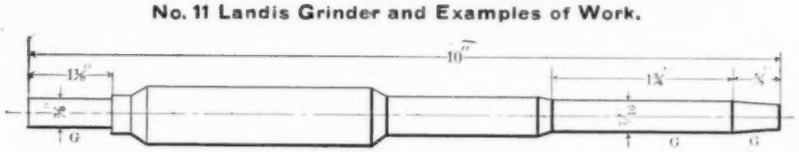
Cast Iron Hand Wheel. .010 Removed from Face and Side in 6 Min.
No. 3 Mach.



Cast Steel. .015" Removed all over and Taper fitted in 12 Min.
No. 3 Mach.



No. 11 Landis Grinder and Examples of Work.



.005" Removed. Time:-3 Min.
Accuracy Limit. -.00025"
⅛ Taper per ft.

Landis Tool Co.,

Waynesboro, Pa., U. S. A.

AGENTS—Walter H. Foster, Manager, New York and Boston. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Liege, Milano, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Can.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Boston, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Heppenstall Forge & Knife Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Foundry & Supply Co., J. D., Cleveland, O.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainerd Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburgh, Pa.

Gears, Cut—*Continued*
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Foundry & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Earle Gear & Mch. Co., Phila., Pa.
Fawcus Machine Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburgh, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Diamond Mach. Co., Providence, R. I.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Iroquois Mach. Co., New York.
Ney, R. W., Pine Plains, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.

Grinders, Tool—*Continued*
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Blount & Co., J. G., Everett, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
New England Mach. Co., Pawtucket, R. I.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Valley City Mach. Wks., Grand Rapids, Mich.
Vandyck Co., J. R., New York.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Cleveland Stone Co., Cleveland, Ohio.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Atkins Co., E. C., Indianapolis, Ind.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
Thompson, Son & Co., Henry G., New Haven, Conn.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Atkins Co., E. C., Indianapolis, Ind.
Diamond Drill & Mach. Co., Birdsboro, Pa.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., New York.

Hack Saws, Power—*Cont'd*
Thompson, Son & Co., Henry G., New Haven, Conn.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Heppenstall Forge & Knife Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Boston, Mass.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Browning Engineering Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, New York.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

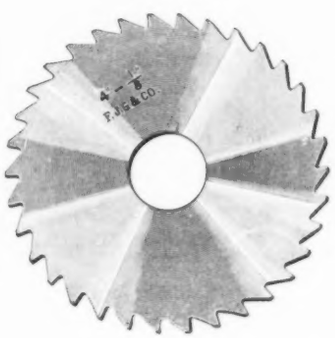
Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.



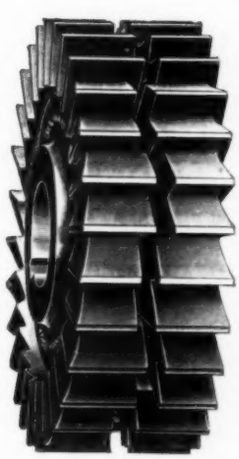
You Can't Go Very Far Wrong In Using Milling Cutters Made By Gay & Ward

judging from those who now use them to the exclusion of all others. Either Gay & Ward Cutters are very good cutters or there is a lot of sadly mistaken people, here and there, all over the world. But then G. & W. couldn't fool the same people twice, so the conclusion must be, that inasmuch as people come back for more, G. & W. Cutters must be right. Book?

GAY & WARD (Incorporated)

Athol, Mass., U. S. A.

New York Office, Carlisle & Van Gelder, 17 Warren St.



Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Norton, A. O., Boston, Mass.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Lapointe Mach. Tool Co., Boston, Mass.
Mitts & Merrill, Saginaw, Mich.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Solid Steel Shear
Heppenstall Forge & Knife Co., Pittsburgh, Pa.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
Bradford Machine Tool Co., Cincinnati, O.
National Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Falkenau-Sinclair Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mergenthaler Co., Ott., Baltimore, Md.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca, Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.

Lathes —*Continued*
Vandyck Co., J. R., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Hardinge Bros., Chicago, Ill.
Loop-Lock Mach. Co., Waltham, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Foote, Pierson & Co., New York.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Greene, Tweed & Co., New York.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
Acorn Engineering & Mfg. Co., New York.
American Fdry. & Mach. Co., Hanover, Pa.
Beaman & Smith Co., Provi., R. I.
Blanchard Mach. Co., The, Boston, Mass.
Dallett Co., Thos. H., Phila., Pa.
Edmonds-Metzel Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Hollingsworth, Samuel, Plainfield, N. J.
New England Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rhodes, L. E., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Williams Tool Co., Erie, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinery Exchange
Philadelphia Bourse, Phila., Pa.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lufkin Rule Co., Saginaw, Mich.
McCrosky, F. B., Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Smith, E. G., Columbia, Pa.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.
Western Mfg. Co., Springfield, O.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Engineer
Hollingsworth, Sam'l, Plainfield, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess Mach. Co., Philadel., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Provi., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Co., J. R., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Beaman & Smith Co., Provi., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.

Milling Machines, Universal
American Tool Works Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mergenthaler Co., Ott., Baltimore, Md.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Co., J. R., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Miniature Tools
Davison Mfg. Co., Brooklyn, N. Y.

Molding Machines
Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
Bullock Elec. Mfg. Co., Cin., O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
Cushman Elec. Co., Concord, N. H.
Eck Dynamo & Motor Works, Belleville, N. J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Keystone Elec. Co., Erie, Pa.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Electric Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Becker Name Plate Co., Aug., Boston, Mass.
Crowe Metal Mfg. Co., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Corporation, Boston, Mass.
Roovers Mfg. Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Factory Schemes—Overhead Trolley Systems and Dipping Apparatus.

BY S. A. WORCESTER.

An Ohio harvester factory, after testing the binder attachments, lifts them from the floor through the hatchways with a special lift, and they are then transferred to the overhead trolley system, which is outlined in Fig. 1. The painter's boy then takes off the sprocket chain, which must not be painted, and hangs it on a hook high on the trolley rod; he also "dopes" one or two polished parts with heavy grease to prevent paint and varnish from sticking to them. The binder is now ready for dipping. On leaving the hatchways *H* the binder goes south and around the curve to the painting tank *P T*. An air lift here raises it out of the trolley hook, lowers it into the paint, then raises it and lowers it into the trolley hook again. It is then pushed along over the draining table *D T*, which returns all the drip to the tank. When eight or ten binders are painted, the first three or four are about through dripping and are pushed on around the curves to any desired point on one of the six paint drying tracks *P D T*. The spring switch, of which there are twenty used in this system, and seventy-five or more in various departments of the works, is a patented invention of my own. Although it absolutely prevents the trolley from being derailed, it never stops it from traveling. If the trolley is on the turnout and going at full speed toward the main rail and the switch tongue is away from the main rail, the trolley throws it over instantly without stopping and runs safely on to the main rail. When the trolley is on the main rail the switch operates like an ordinary spring switch, and is pushed over by the trolley and thrown back by the spring after the trolley passes. After the binders have stood twenty-four hours the paint is fairly dry, and they are run south and dipped in the varnish tank *V T*, using the air lift and draining as before, and drying for twenty-four hours on the varnish drying tracks *V D T*. The boy then takes the sprocket chains off the trolley hooks and places them on the sprockets again. The binder is then taken to one of the final run-off stands *R O S*, over which travels an air lift which relieves the trolley of its load. The binder is then run for a few minutes to see that nothing is clogged by paint, and is then hoisted by the air lift and lowered into a crate on a truck. The crate is then nailed up and the binder is taken to the warehouse. The empty trolleys are returned in trains of fifteen or twenty by the rail *E T R* to the north end of the line, and are ready to carry more binders as they come through the hatchways.

Before installing this system, fully three-fourths of the floor of the larger room and one-half of the smaller room were necessary for painting the binders. The trolley system occupies not more than half of that space and makes an immense saving in paint and labor cost. Instead of pushing one binder on a truck, a boy now pushes three to five binders at once, and with surprising ease, considering the short curves, of 48 inches radius.

Having noted a considerable loss of time in hooking and unhooking, raising and lowering with the air lift, I invented the counterbalanced lowering and lifting arrangement shown in Fig. 2. The moving section *S* of the trolley rail is riveted to the yoke *Y*, which slides vertically in guides, not shown, at the rear of the stationary rails, and is held up by the rope which passes over sheaves and has attached at its other end a weight or spring. The device was at first used for light work, a harvester wheel, weighing about 150 pounds. A simple weight moving in a guide box was the counterbalance in this case and was heavy enough to slightly overbalance the yoke *Y* and attached parts with the trolley and its load. When the loaded trolley runs on to the track *S*, the spring latch *L* drops over the trolley lug *T L* and stops the trolley and holds it from moving in either direction until it has been lowered and raised again. The workman now pulls perhaps 5 to 15 pounds on the trolley rod *T R*, and the yoke *Y* and rail *S* with the trolley and harvester wheel are all lowered until the wheel is immersed in the paint. As the paint now floats about one-fourth of the weight of the iron wheel, it rises quickly when the pulling is stopped, and the operator steadies it up to prevent its striking too hard. As the latch *L* in rising strikes

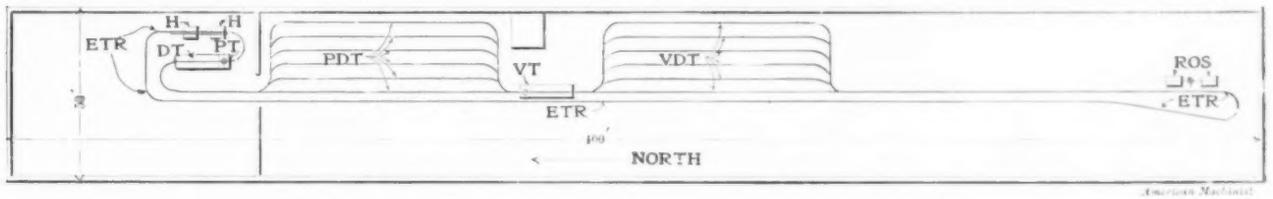


FIG. 1. PLAN OF OVERHEAD TROLLEY SYSTEM IN A HARVESTER FACTORY.

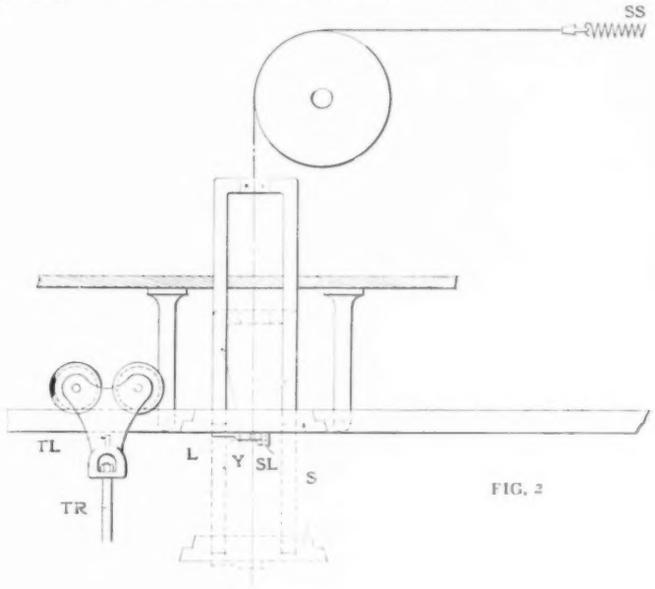


FIG. 2

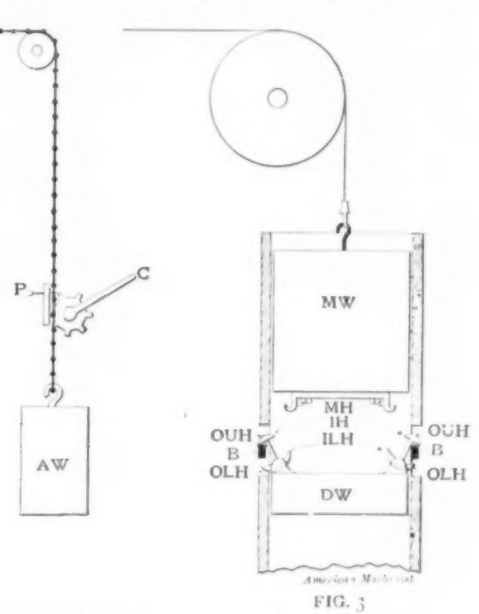


FIG. 3

FIG. 2. COUNTERBALANCED LOWERING AND LIFTING ARRANGEMENT.

the spring lifter *S L*, the latch is drawn away from the trolley lug *T L*, and when the rail *S* has returned to place the trolley can be pushed along, carrying the work over the draining table. Just after leaving the latch *L* the trolley lug strikes *S L* and releases the latch, which swings back ready to engage the next trolley. This device is patented. These operations are performed very rapidly, and it takes only about three to five seconds to stop the wheel in place over the tank, dip it, raise it and give it a push, which sends it along over the draining table until it strikes the next wheel.

After this arrangement succeeded so well it was decided to paint with a priming coat the mower with wheels on, weighing 460 pounds, using the dipping device just described, with a weight sufficiently heavy. A single weight was first tried, but it was found that when the mower frame was partly immersed and the wheels still half-

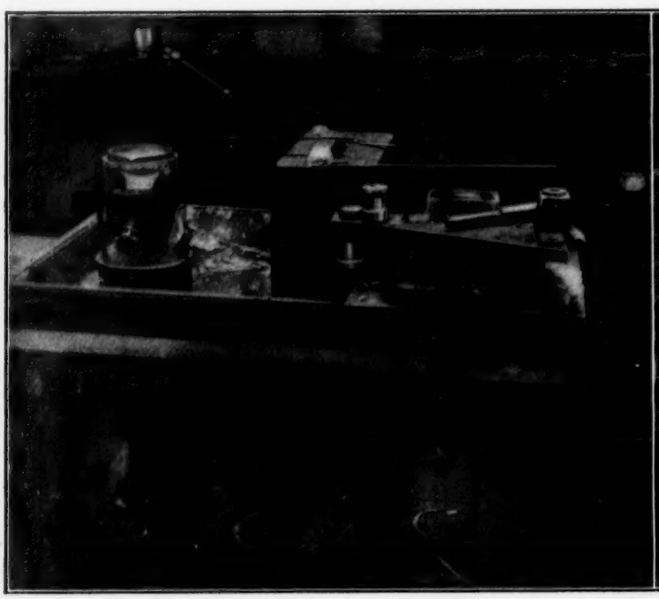


FIG. 16. BABBITTING BENCH.

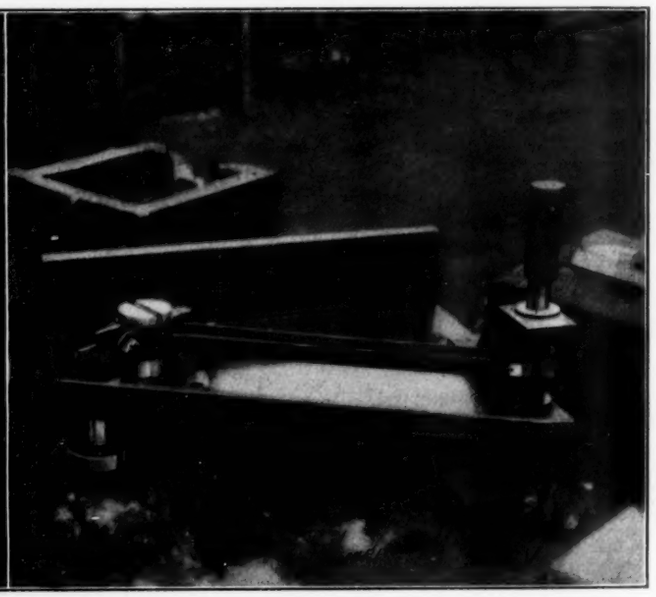


FIG. 17. OLDS CONNECTING-ROD BABBITTING JIG.

way out, the flotation (about 120 pounds) was so great that one man could not immerse it. So I designed the self-detaching and attaching weight shown in Fig. 3. It is so arranged that when the main weight *M W* is in its lowest position and the rail *S*, Fig. 2, is in place ready to receive the trolley with its mower suspended, the weight *D W* is attached to *M W* by the inner hooks *I H* hooking over *M H*. These two weights rise and fall in the guide box, a short upper portion of which is shown, and which has slots, not shown, in the sides to clear the swinging hooks *O L H*. As the dipping yoke *Y*, Fig. 2, with its mower is lowered, the two weights rise together until the mower frame is partly immersed, when the flotation begins to retard the movement. At this point the hooks *O L H* strike the stationary bars *B*, throwing *I H* outwardly, so as to let go of *M H* and hook *O U H* over *B*, as shown. This reduces the moving weight about 125 pounds, and the mower is easily immersed by one man. As the mower rises again and the weight *M W* descends, it reattaches *D W* by a reverse operation, the hooks *M H* striking *I L H* and throwing *I H* inwardly, so as to hook over *M H* while *O U H* swing off of *B*. The sliding surfaces of hooks and bars were "doped" occasionally with heavy grease and worked with ease and smoothness and very little jar. One man has dipped 250 mowers in 12 hours. A later development of the counterbalance, the spring *S S*, appears in Fig. 2. This spring, which is made by hooking together mower springs to a length of 100 feet, and slides in a small trough for part of its length to prevent undue sag, is used, with the tension adjuster shown, for dipping four mower cutter bars at once. The weight of the four bars varies with their length from 280 to 410 pounds. The depth of immersion is so small in this case that it is easy to give enough momentum by pulling to dip the bars and to overcome the slight increase in tension of the long spring. The sprocket chain is drawn down by the crank *C*, which is conveniently placed, and the chain is fastened by the pin *P* when at the right tension. Marks on the chain, located by experiment, enable the workman to give the spring the right tension, when changing the length of bars, before running the trolley over the tank. The change sometimes has to be made several times in one day, and in order to make the work easy the weight *A W* of about 345 pounds, is attached as shown. The spring having very little inertia, the load to be started is little more than half what it would be if the counterweight were used, and the dipping operation is proportionately easier or quicker. One important advantage of these counterbalanced rigs is that they are independent of compressed air or any other source of power and can be used just as well when the power is shut down.

Automobile Construction—VI.

BY HUGH DOLNAR.

After the Oldsmobile cylinder has its back end faced on an expanding arbor screwed to the nose of a stiff lathe spindle, as shown at page 1589, Vol. 26, it may have the crankshaft boxes completed by babbitting, as soon as the caps are screwed on. These caps are separate from the front part of the crank box, so that the journals are formed wholly in the cylinder casting, not partly in the cylinder and partly in the front crank-box extension.

Mr. Olds, in discussing the construction of the motor, remarked that "A great many persons say that a babbitt box is a poor job, cheap work, and not fit for heavy duty."

This led me to reflect on the matter, and it really seems that there is a commonly held impression among constructors that a bearing made by simply pouring fusible metal into a cast iron seat, is not so good a job as if the seat were finished and the anti-friction brasses or babbitted parts were machined and scraped to place, and the journal box then fitted by boring and scraping to the shaft journal. There seems to be a general supposition that the babbitted box which is simply poured and then passed into service without machine or hand fitting, must be an inferior production.

It is very common practice in work of some size to fit cast-iron bottoms, cheeks and caps of either cast iron or bronze to a finished journal box, and to line these four separate pieces with babbitt wholly in case of the cast iron-boxes, or partly in case of the bronze boxes. For horizontal engine shafts having boxes capped horizontally, the adjustable "cheeks" or "quarter-

brasses" are needful, as the pull and push of the piston are resisted mainly by them, and in work of some magnitude there is good reason for the introduction of the quarter-brasses in combination with the horizontally divided journal box. It is well known, however, that the "Tangye" horizontal engine bed, having the crankshaft journals capped at an angle of from 30 to 40 degrees, may give good service with only top and bottom box sections, and a good many such frames have been made, and have given satisfaction in use, where crankshafts up to possibly as much as 8 inches diameter were journaled in babbitted bearings, poured directly into the engine frame and cap castings.

Mr. Olds went on to say that he used a special lining metal costing 45 cents per pound, and that the Oldsmobile crankshaft boxes were extremely durable, although no hammering or hand fitting was done on them after pouring.

"Peening" with a ball-peen hammer was an essential step in the construction of the original Pratt & Whitney lathe spindle bearings, the cast-iron spindle boxes which were fitted to the headstock seats in the usual manner, being drilled with a great many holes close together through the babbitt flanges, and the babbitt being poured on an arbor much smaller than finished diameter. Then the babbitt was effectively "peened" by hand, so as to stretch it in the box in all directions to make it lie snug and solid against the box walls, and the journal lining was then bored to size, and finally fitted by scraping to the red-leaded spindle with great care, and then relieved by scraping to give "oil room," all this being done by experienced mechanics, making a tedious and costly job. Of course the babbitt would not have stayed in the boxes through the peening operation had it not been extremely well held by the great many holes drilled through the box flanges at both ends, by which the strong, ductile, high-grade babbitt used was so efficiently retained that it never came loose in the stretching process.

It is also a common practice in high-grade work to expand the soft metal in lined boxes by forcing a tapered arbor through in a broaching press, bolting the box and cap together for the operation and afterward boring and fitting the box by scraping, or, in some cases where sliding fits are made in solid babbitted boxes, taper arbors of working diameter are used in broaching and then the co-acting piece is forced in and fitted by being reciprocated very slowly, flooded with oil, in a special machine tool built for the purpose, several hours of this slow running being required to give the parts freedom enough to do their intended work.

These examples show the general distrust with which a babbitted box which is simply poured and then set to work is regarded by some constructors, and there is no doubt whatever that, given a careless, thick-headed "handy man," cheap, low-grade "babbitt" (any alloy gray in color and melting readily passes as "babbitt metal"), poor journal boxes can be, and often are, produced.

On the other hand, reputable makers of lining metal know perfectly well how to produce a composition which will not only wear well, but will not shrink enough in cooling to make peening or stretching needful, and for the vertically divided crankshaft journal of the horizontal Oldsmobile motor, I do not believe a better bearing could be produced than by babbitting with a high-class metal, and omitting all operations subsequent to pouring.

No special care is taken in providing means for retaining the lining metal in the castings; the boxes are not flanged, and are simply drilled with shallow holes on each side in the usual manner, the babbitt being poured on a special fixture—not with the motor crankshaft as a babbitting arbor, and one young man being constantly employed in lining the cylinder boxes, caps, and connecting rods.

FIG. 18. OLDSMOBILE CYLINDER WITH BOX-BABBITTING JIG IN PLACE.

The Olds babbitting bench is shown in Fig. 16. This construction, like everything else in the Oldsmobile shops that I noticed, was as cheaply made as it could be and well serve its purpose, and my visit to this factory very forcibly impressed upon my mind the extreme folly of making the details of a manufacturing plant cost one single dollar more than is needed to secure cheap and good results. Mr. Olds has complained that these descriptions of his construction methods do him an injustice. To me, accustomed to the more elaborate tool and fixture constructions of some Eastern factories, the careful avoidance of all needless expenditure in the Olds shops, as well as the relentless renunciation of all useless finish on the wagon itself, formed a striking object lesson in factory economics, and led me to reflect seriously on the propriety of "making a job of it while you are about it," and to conclude that while "a job well done is twice done" is a good proverb, it is quite certain that a job better finished than its productive function demands is very badly done, no matter how satisfying it may be to the mechanic's eye, because it has extinguished values without adequate return and put good money where it can never be recovered.

This Olds babbitt bench consists of a shallow wooden tray, having beveled sides, with angle irons at the corners, lined with sheet metal and supported on substantial wooden legs. At the left hand there is a ladle supporting ring frame mounted on top of a "blow torch" supplied with liquid fuel; a heating arrangement which has come into very large use for many purposes within the past few years. The even steadiness of the heat is shown by the well-defined outlines of the flame shown in the illustration as impinging on the round ladle bottom, and there is no doubt that very uniform results obtained by the young man who worked at this bench were largely due to the ease with which he could regulate the temperature of the melted metal. I watched his work for some time, and noticed that he was pouring with the same tint of skin of oxide on top of the melted metal always.

The substantial finished slab of cast iron with the studs and arbor which go to make up the rod babbitting jig are shown (not in use) at the right front of the babbitt bench. This rod babbitting fixture is shown on a larger scale in Fig. 17.

Fig. 18 shows an Oldsmobile cylinder standing upright in a rough wooden box made of heavy plank, held in place by rough blocks slipped down inside between the cylinder and box sides, and having the babbitting fixture in place. As the top of the cylinder as it stands in the illustration is milled in the cylinder boring machine at the same setting with the boring, it is of course as truly at right angles to the cylinder bore as the machine cut will make it, and this makes it very easy to locate the pouring jig made with a long, round part fitting the cylinder bore, and cross arms, all finished accurately, carrying the semi-cylindrical box molds with the end pieces attached which determine the form and position of the babbitting. The packing is a loose coil of oakum drawn up to stop the small clearance opening between the ends of the boxes and the fixture. As before said, the boxes have no flanges, so that the crankshaft is held endwise as well as sidewise by the babbitt. The packing is retained by crossing it on top of the jig with a single knot on each side, two lengths of the oakum "roving" being used. The top piece (double T-form) fixes the depth of the journals, and the sidewise location is from the cylinder bore. As I recall this operation, not more than a minute or two was consumed in making a cylinder ready for pouring, and the work was extremely uniform in appearance. I noticed the care taken to have the metal a certain heat at the time of pouring, and presume this to be an essential point. I saw no failures, and there was no delay at any stage of the

proceeding, except in regulating the heat of the metal.

By babbitting with a jig and gaging the shaft diameter, which was done to the micrometer, a very nearly uniform oil clearance was easily had, which is highly important.

The rod babbitting fixture was merely a heavy angle piece, without feet, blocked up as shown when in use, because of the studs on both sides. One side of it is used for one end of the rod and the other side for the other end of the rod. First, one end of the rod is poured, then the poured end is placed on a stud which fits it and the other end is poured. The rod is capped at the crank end.

I do not believe there is any way in which these rods and journal boxes could be more uniformly finished, or more suitably sized, than by the means here shown. The labor cost was extremely small, and the special plant used was strikingly inexpensive.

Who Really Invented the Link Motion?

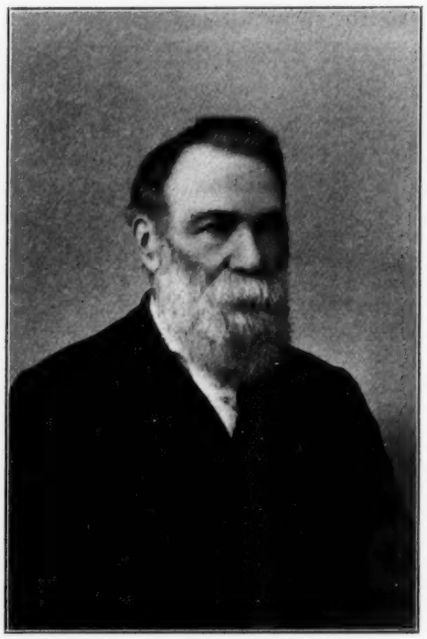
BY W. L. CAMPBELL.

This may seem rather a late day to add to a discussion apparently closed half a century ago and to attempt to prove, despite all existing works on locomotive history, that Williams, and not Howe, invented the link motion. But facts supporting that view of the case have been brought to light, and it is but just and fair that they be here recorded.

William James, of New York, is said to have been the first to apply the link to a steam engine. This was between the years 1830 and 1840, while James was experimenting with steam road carriages. The road-carriage venture proved a business failure, and the merits of the James link seem not to have been recognized at the time. While some writers since then have given James due credit for his improved valve motion, they all concede to William Howe, a patternmaker in the Stephenson works, at Newcastle, England, the honor of inventing the ordinary shifting link, or what is known as the Stephenson link motion. It is this Stephenson link motion to which this article relates, and the facts presented come from no less an authority than Mr. Ralph L. Whyte, of Hamilton, Ont., who was not only chief draftsman in the Stephenson works when the link motion was invented, but was, in conjunction with Mr. William Hutchinson, who was manager of the works, the first to lay the link motion down full size on paper.

Mr. R. L. Whyte was born at Newcastle, England, in the year 1820. In 1835 he entered the drawing office of Robert Stephenson & Co., Newcastle. His apprenticeship indenture is reproduced herewith. This interesting document, it will be noted, bears the signatures of Mr. Whyte; his father, Alexander Whyte, of Noxham, England; Edward J. Cook, business agent for Mr. Stephenson, and that of Mr. Robert Stephenson himself. As indicated on the apprenticeship papers, the salary paid during the first six years ranged from three shillings and sixpence (84 cents) to ten shillings ($2.40) weekly. But Mr. Whyte doubtless counted himself lucky in receiving any remuneration at all, as most of his fellow apprentices—"pupils," as they were called—were required to pay a premium for the opportunity they were afforded of learning engineering. And at that there were always more applicants than could be accommodated.

Mr. Whyte remained with the Stephensons some eight years, attaining to the position of chief draftsman, when he left England to take charge of an enginering works in France. A few years later, accompanied by his wife, who also is still living, he sailed for America, finally settling in Canada. For twenty years he was



RALPH LITTLE WHYTE.

chief clerk in the Custom House at Hamilton. He is now in his eighty-fourth year, and although retired from business, is strong and active for his age.

Mr. Whyte possesses an exceptionally good memory. Although he has been out of active touch with locomotive building for more than fifty years, his recollections are clear and distinct, and he can throw direct light on many moot points connected with the early development of the locomotive. While at the head of the drawing office of Robert Stephenson & Co. Mr. Whyte had charge of much important work, not the least noteworthy of which was the designing of the "North Star," the first engine ordered by the Great Western Railroad. The drawings for this engine were all made under Mr. Whyte's supervision.

Returning now to the link motion: Mr. Whyte, as chief draftsman, was not only assigned to lay down this motion full size, but he was in direct touch with the circumstances preceding and attending its invention; and it might be said that it was the action of Mr. Whyte, in sending Williams with his sketch to Howe, that made it possible for the latter to claim the link motion as his own invention. Williams, a modest, unassuming lad, was the youngest draftsman in the office, and to him Mr. Whyte insists that the credit of the invention rightfully belongs.

Before presenting Mr. Whyte's contentions and giving the true story of the invention of the link motion, in order to show how the matter has been distorted in history and how the present day version has come to be accepted, the references to this subject in some of the more prominent works on locomotive development will be briefly reviewed.

In 1846 the Glasgow *Practical Mechanic and Engineer's Magazine* published a series of articles describing the principal types of valve gear which had been in use up to that time. In the April number the locomotive link motion was taken up. This "elegant apparatus," the article states, was invented by Mr. Williams. In the continuation of the article in the May issue it is explained that a communication had been received from William Howe, of Newcastle, contradicting the statement that Mr. Williams was the inventor of the link motion, and claiming that Howe, himself, invented the link as originally applied by Mr. R. Stephenson to locomotive engines, but conceding to Williams the original idea of the link. Howe forwarded to the magazine a sketch of Williams' scheme, stating that it had never been carried into effect. A front elevation and a side view of the Williams arrangement are shown in the article referred to, which, after dealing with the faults and impracticability of the device, reads: "Mr. Howe informs us, a fact which we need scarcely repeat, that the scheme was never actually put into practice, but leaves us to presume that it formed the ground work for the invention of the link motion." The matter is finally disposed of as follows: "As we have no wish to make our pages the vehicle of a useless controversy, we give insertion to the above drawings merely as a matter of common justice to Mr. Howe, the validity of whose claim we must leave our readers to decide."

The editor of this Glasgow monthly, though non-committal enough, would seem to accord to Williams at least some consideration, a tendency conspicuously lacking in subsequent writers on the subject, practically all of whom award to Howe undivided credit for the invention.

It is true that D. K. Clark in *Railway Machinery*, one of the first works on the locomotive, is generous enough to mention Williams' name in connection with the invention of the link motion. From Clark's introduction to the subject the following is taken: "Nothing but an impulse of genius could have given birth to this exquisite

motion; and though in its first conception by Mr. Williams, at one time of Newcastle, it was rude and even impracticable, the idea was there, and it had only to be clever motive since the introduction of the blast pipe and multitubular flue." Considering that the first inception of the link was by Williams and that had it not been for sonably be wondered to whom Mr. Clark attributed the genius, "nothing but an impulse" of which "could have given birth to this exquisite motion," and if not alto-

W. & H. Mitchell, Printers, Newcastle.

This Indenture made the Seventeenth Day of April in the Year One Thousand Eight Hundred and Thirty Seven between Ralph Little Whyte ——— Son of Alexander Whyte of Bepham in the County of Northumberland ——— and the said Alexander Whyte ——— of the one Part, and ROBERT STEPHENSON, of Newcastle upon Tyne, Engine Builder, of the other Part, WITNESSETH, that the said Ralph Little Whyte ——— of his own voluntary Accord, and by and with the Consent of the said Alexander Whyte ——— his Father, testified by the said Alexander Whyte ——— being a Party to and executing these Presents, doth put and bind himself Apprentice to and with the said ROBERT STEPHENSON, to learn the Art, Trade, or Business of a Draftsman ——— so far as the same relates to the said Trade or Business of an Engine Builder, and to serve the said ROBERT STEPHENSON, and his present and future Partners, in the said Trade or Business of an Engine Builder, and the Survivors and Survivor of them, and their and his Partners, from the Day of the Date hereof, until the full End and Term of Six ——— Years from thence next ensuing, and fully to be completed and ended; and the said Ralph Little Whyte ——— and Alexander Whyte ——— do hereby, for themselves jointly, their Heirs, Executors, and Administrators, and each of them, doth for himself severally, his Heirs, Executors, and Administrators, covenant with the said ROBERT STEPHENSON, his Executors and Administrators, in Manner following, that is to say, that during the Whole of the said Term the said Ralph Little Whyte ——— shall and will faithfully serve the said ROBERT STEPHENSON, and his present and future Partners, in the said Trade or Business of an Engine Builder, and the Survivors and Survivor of them, and their and his Partners, as an Apprentice in the said Art, Trade, or Business of a Draftsman ——— so far as the same relates to the said Trade or Business of an Engine Builder; and shall and will be true, just, and faithful to them and every of them, and the Agent and Agents of them and every of them; and their Secrets keep, and their lawful Commands every where and in every Thing obey; and shall do no Damage to them or any of them, nor see it done by others, but to the best of his Power prevent or forthwith give Notice of the same; and he, the said Apprentice, shall not embezzle, or waste, or lend the Goods of his said Masters or any of them unlawfully to any; and Hurt to his said Masters or any of them he shall not do, or cause or procure to be done; and he shall neither buy nor sell without his Master's Leave; at Cards, Dice, or other unlawful Games, he shall not play; Taverns, Inns, or Alehouses he shall not haunt or frequent, unless it be about his Master's Business; nor from the Service of his said Masters Day or Night shall absent himself; but in all Things, as an honest and faithful Apprentice, shall and will demean and behave himself towards his said Masters and every of them, as well in Words as in Deeds, during all the said Term. And the said ROBERT STEPHENSON doth hereby, for himself, his Heirs, Executors, and Administrators, covenant as well with the said Ralph Little Whyte his Executors and Administrators, as with the said Alexander Whyte ——— his Executors and Administrators, that they, the said ROBERT STEPHENSON, and his present and future Partners, and the Survivors and Survivor of them, and their and his Partners, or some or one of them, shall and will, during the Term of the said Apprenticeship, teach and instruct, or cause the said Apprentice to be taught and instructed, in the Art, Trade, or Business of a Draftsman ——— so far as the same relates to the said Trade or Business of an Engine Builder, in the best Way and Manner that they or any of them can; and also shall and will pay, or otherwise allow, the said Apprentice, during the said Term, the weekly Wages following, that is to say,—

Four Shillings and six pence Weekly during the first Year of the said Term. Four Shillings and six pence Weekly during the second Year thereof. Five Shillings Weekly during the third Year thereof. Seven Shillings Weekly during the fourth Year thereof. Eight Shillings Weekly during the fifth Year thereof and Ten Shillings Weekly during the sixth and last Year of the said Term

And it is hereby mutually agreed by and between the said Parties hereto, that in Case the said Apprentice shall, at any Time or Times during the said Term, be absent from his said Work by Reason of Sickness, Lameness, or from any other Cause, then and in such Case he, the said Apprentice, shall not be entitled to receive any Wages for or in respect of such Day or Days during which he shall be so absent from his said Work as aforesaid; and further, that he shall, after the Expiration of the said Term, serve such additional Time as he shall during the said Term have been absent from his said Work as aforesaid, and shall only be entitled to receive therefore such Wages as he would have been entitled to have received in respect of the Day or respective Days for which such additional Time shall be substituted; and further, that in Case the said Apprentice shall be required at any Time during the said Term to work for his said Masters, or any of them, before the Hour of Six o'Clock in the Morning, or after the Hour of Six o'Clock in the Afternoon, he, the said Apprentice, shall be paid for such Overtime at the Rate of One-Quarter more than his weekly Wages for the Time being, provided always that the said Apprentice shall not be entitled to be paid for any such Overtime unless he shall have worked his full Number of Hours during the preceding Weeks, it being the Intention of the said Parties that any Deficiency in the regular and ordinary Times or Hours of Working may, if the said Masters think fit, be set off against such Overtime as aforesaid until such Deficiency shall be made up; and further, that the said Apprentice shall be allowed, between the said Hours of Six o'Clock in the Morning and Six o'Clock in the Afternoon, Half an Hour for Breakfast and One Hour for Dinner. In Witness whereof, the said Parties to these Presents have hereunto set their Hands and Seals the Day and Year first above written.

Signed Sealed and delivered by the said Ralph Little Whyte Alexander Whyte and Robert Stephenson in the presence of Edwd Hook

Ralph Little Whyte
Alexander Whyte
Robt Stephenson

FAC SIMILE (REDUCED) OF THE APPRENTICESHIP INDENTURE OF R. L. WHYTE, SIGNED BY ROBERT STEPHENSON.

erly worked out by Mr. Howe to render it, in conjunction with the lap of the valve, the most felicitous acquisition to the loco- Williams and his idea it would have been impossible for Howe to work out his "invention" of the link motion, it might reagether to Howe, why Howe should be given full credit for the invention. From Clark's "Railway Machinery," two

sketches are reproduced herewith. Fig. 1 shows what is termed the Williams link. Fig. 2 is the familiar Howe, or Stephenson link. While ready enough to criticise the Williams arrangement, D. K. Clark tenders no information to strengthen Howe's claim, and apparently takes for his authority for Williams' connection with the invention the letter written by Howe to the Glasgow magazine.

But in this respect "Railway Machinery" is hardly comparable with "Locomotive Engineering and Mechanism of Railways," by Zerah Colburn, published 1864. In this illustrious work the subject is opened as follows:

"In 1842 or 1843 Mr. Williams, of Newcastle, is said to have designed the attempt at a link motion shown in Fig. 73 (Fig. 1), although this is copied from an *ex parte* drawing sent to the Glasgow *Practical Mechanic and Engineer's Magazine* in 1846, by Mr. William Howe, of Newcastle, who claimed the form of link motion now in general use as his own invention. An apology is necessary for introducing such a mechanical blunder into these pages; but it has been said by those who ought to know better that Williams' contrivance 'contained the germ of the link motion, and needed only to be cleverly worked out to render it the most felicitous acquisition which the locomotive has received since the combination of the multitubular boiler and blast pipe!' It does not, on the contrary, require a second glance to perceive that the notable 'design' did not permit of making half a revolution of the driving wheels except by tearing this pseudo 'link motion' to pieces."

As it is not the purpose of this article to defend this "mechanical blunder," and as this "pseudo link motion" was never meant to be applied to a locomotive, and, moreover, as it was never intended by its originator to be seen outside of the Stephenson works—although this is anticipating—it is needless to deal at greater length with the criticism accorded the Williams design by Zerah Colburn.

It should be noted here also that the sketch referred to and showing the mechanism so fiercely criticised by Colburn was not made by Williams himself, but by Howe, and formed a portion of a letter intended by Howe to create the impression that Williams had invented nothing, or at least nothing of importance. There is nothing to show but that if Williams himself had made this sketch of his invention it might have been differently made.

While Williams fared badly enough at the hands of D. K. Clark and Zerah Colburn, he is ignored altogether by Angus Sinclair, Clement E. Stretton and other modern locomotive historians. These writers, however, appear to be possessed of more particulars connected with the invention of the link motion, and from C. E. Stretton's "Development of the Locomotive Engine" (1902) the following is quoted:

"Mr. William Howe, who was a fitter in the employ of R. Stephenson & Co., decided to place a curved link between the ends of the forward and backward eccentric rods to take the place of forks. He made a pencil sketch and wooden model, which were shown to Mr. Robert Stephenson, who, seeing its merits, ordered it to be fitted to all engines constructed at his works." Further on Mr. Stretton says: "Some correspondents to the newspapers have expressed the opinion that the 'introduction of the "link" was not an invention but an improvement.' By whichever

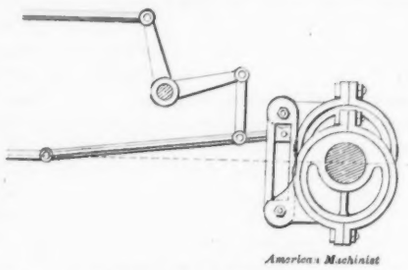


FIG. 1. WILLIAMS LINK MOTION AS DEPICTED BY HOWE.

name it be known, the fact remains that Mr. Howe's introduction of the link at once removed all the difficulties which had for years caused trouble with the 'fork motion,' and it did far more than this, by producing a complete and simple means of cutting off steam for expansive working." And "The 'link motion' is frequently spoken of as Stephenson's, but this is an error, as Howe was the inventor, and Mr. R. Stephenson himself always spoke of it as Howe's."

How falsely Williams has been represented by the earlier writers and how unjust is the omission of his name in connection with the invention of the link motion by the later writers, can best be judged after reading the following account of the invention, related to the writer by Mr. Whyte, who probably alone survives those with whom he was associated at the Stephenson works, and than whom there is no one living competent to speak on this subject with greater authority. Mr. Whyte is a prominent citizen of Hamilton; he has always been known as a man of the strictest integrity and of the highest principles, and there is no questioning the veracity of any statement he would make. But he fully realizes the importance of this matter and desires it to be made known that he is prepared to take his affidavit as to the accuracy of what is said in this article concerning his connection with the link motion.

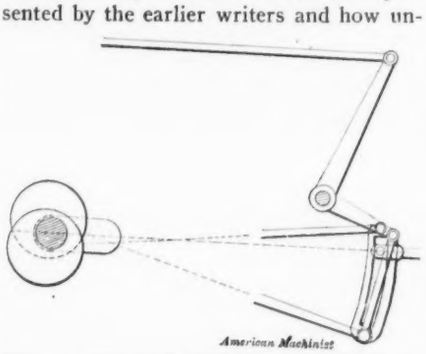


FIG. 2. THE LINK MOTION AS CLAIMED BY HOWE AND CREDITED TO HIM BY COLBURN AND CLARK.

In the year 1842, one morning about 6 o'clock, Mr. Williams, the youngest lad in the drawing office of Robert Stephenson & Co., of which Mr. R. L. Whyte was then chief, came to Mr. Whyte with a sketch of an improvement in the locomotive valve gearing. The chief draftsman was struck with admiration of the idea, realizing at a glance its possibilities. The sketch was the same as that shown in Fig. 1, consisting of a straight slotted link attached to the eccentric straps. The slide block in the slotted link hung from the end of a radius link from the valve spindle. The idea the sketch was made to illustrate was that by adjusting this slide block toward one or the other end of the link the valve could obtain the motion of either the forward or backing eccentric. Shifting the block toward the center of the link would reduce the travel of the valve and produce variable expansion. The motion would bring the engine under the direct control of the driver and allow him to make a quick reverse. Williams remarked that since making the sketch shown to Mr. Whyte (Fig. 1) he had further developed his idea, and that he had decided to place the link at the ends of the eccentric rods, curving it to the radius of the rods, and to attach the slide block directly to the end of the valve stem, effecting the reverse of the engine and variation in expansion by shifting the link vertically to any position required. Before doing anything further, Williams suggested that he make another sketch embodying these improvements. Mr. Whyte heartily accorded with this further development of Williams' idea; but as the introduction of the link itself was the most vital feature, he advised Williams, before proceeding with his suggested improvements, to have a skeleton model made from his first sketch, by Mr. Howe, who was then foreman of the pattern shop, and immediately to show this model to Mr. Wm. Hutchinson, a partner of Stephenson and general manager of the works. Williams then took the sketch to Mr. Howe, and it is but reasonable to assume that in explaining his ideas to the head patternmaker the lad was just as frank as he had been when discussing the subject with the chief draftsman.

This sketch, it must be repeated, represented but one stage in the development of Williams' idea; the motion it outlined was not intended to be applied to a locomotive, and the drawing was not meant to go farther than the pattern shop in the Stephenson works, much less to be published and, as "Williams' link motion," made the target for shafts of misapplied criticism.

Two mornings after the incident men-

tioned, Mr. Hutchinson came to Mr. Whyte and told him that Howe had made an important invention. This "invention" proved to be nothing more than Williams' link, but curved and placed at the ends of the eccentric rods (Fig. 2), embodying the identical improvements Williams had outlined two days before to Mr. Whyte, and which Mr. Whyte had advised the lad to defer making until he could get from the head patternmaker a skeleton model of the first sketch. At once detecting the deception, Mr. Whyte protested there and then that this "invention" was nothing but an impudent imposition, and he gave to Mr. Hutchinson the facts as stated above. Needless to say, the manager was surprised and shocked at this, and seemed scarcely able to believe what he had heard, as Howe had not mentioned Williams in any way and had given Mr. Hutchinson to understand that he (Howe) was alone responsible for the invention.

At that time Mr. Whyte was under engagement to go to France, but he was requested by Mr. Hutchinson to defer his departure for a few days and lay down the link motion full size. The managing partner and Mr. Whyte worked a fortnight at this, until they were fully satisfied with the importance of the invention—that besides bringing the locomotive perfectly under the driver's control, the motion afforded a variable cut-off, allowing the steam to work expansively, thereby effecting a great saving in fuel. Mr. Whyte declares that there are absolutely no grounds for the contentions by some writers that all these capabilities of the link were not recognized when the motion was invented.

During the time that the link motion was being laid down Mr. Howe was never in the drawing office, nor was his name even mentioned in connection with the invention, and Mr. Whyte left for France with the conviction that Williams would be well rewarded. As stated before, Mr. Whyte has been out of touch with locomotive building for over half a century, and it was not until a few years ago that he learned that Williams had been robbed of the credit of this invention.

Concerning the statement in C. E. Stretton's work that Howe made a pencil sketch and wooden model of the link, which were shown to Mr. Robert Stephenson, Mr. Whyte declares that as a matter of fact Mr. Stephenson was not in Newcastle at the time the link was invented, and that he did not see the sketch until the motion was drawn out full size and Mr. Whyte had started for France. Mr. Whyte never saw Mr. Hutchinson again, he having died, as had, also, Mr. Stephenson, before Mr. Whyte returned to Newcastle.

To any who still hold, notwithstanding Mr. Whyte's revelations, that the improvements made by Howe on Williams' idea—improvements which were anticipated by Williams and which he intended to embody—constitute the invention of the link motion, and that Howe is entitled to full credit for such, this article will at least be of interest in the publicity it gives to certain relevant facts associated with this invention which the historians appear to have overlooked.

Whatever glory the link motion may have shed upon Howe, certainly his connection with its invention, in view of Mr. Whyte's disclosures, stands out in no enviable light, and perhaps the best that can be said for this patternmaker, unless he afterwards made full restitution to Williams, is that such methods as he employed in "cleverly working out" this invention were not confined to William Howe, nor, it is to be regretted, to William Howe's day.

THE INCOGNITO CO. LTD.

Department Subdivisions

Symbol	Name
A.	Plant Additions
B.	Repairs to Machinery
C.	Repairs to Steam, Heat and Light Plant
D.	Repairs to Buildings
E.	General Labor, Cleaning, Oiling, &c.

American Machinist

FIG. 1. CLASSIFICATION OF UNPRODUCTIVE OUTLAY.

THE INCOGNITO CO. LTD.

Date. *20-Dec-03.* Dept. *17 A.* Order No. *X 559.*

The Storekeeper,
Please supply the following:-

		@ Cost	
1 Set.	*Castings for power press*	*95*	*00*

Storekeeper. *H. Smith.* Foreman. *W. Johnson*

American Machinist

FIG. 2. REQUISITION FOR MATERIAL.

Units of Driving Force for Lathes.

For comparing the powers of various lathes, the *American Machinist* [English edition] gives Mr. E. P. Hetherington's valuable suggestion that the diameter of the large step cone on the fast headstock be multiplied by the width of the belt and by the total gear ratio, the dimensions being taken in inches. The results he calls units, or units of belt and gear effort, and they offer a basis of comparison for machines of the same size by different firms. Taking, for example, some 12-inch lathes, results varying from about 70 to 1,700 units or more can be found.—*Work.*

A Card Index System for Obtaining the Cost and Distribution of the Non-Productive Labor.

BY GEO. P. PEARCE.

It is now absolutely necessary for any progressive firm to have a good system of cost-keeping. Many firms find that, while the cost-keeping of the productive labor and material is comparatively easy owing to each department running almost continuously on a similar product, it is very difficult to draft out a suitable system to take care of the non-productive labor and material for repairs, plant additions, building repairs, breakdowns, etc. The chief difficulty arises from the diverse nature of the work and from the necessity, in case of breakdowns, of not having a lot of red tape to interfere with the prompt starting of repairs. I know of firms which lose $10, and more, per minute while a shutdown continues, and hence obstructive systems generally die out, or if they do not, it is because they are watched and followed up very closely; but watching and following up a system costs money, and the easier and simpler a system is, as long as it is accurate, the cheaper it will be to run. The following is a system of my own, which, although it does not go down to such fine points as some, is, for all practical purposes, accurate.

We will start by assuming that our plant is divided into numbered departments and has a storeroom, and we will divide each department into five sections, called A, B, C, D, E, which will divide the costs in accordance with the form shown in Fig. 1, which is printed and distributed among the various foremen and the unproductive help, to prevent all misunderstanding. All raw material must be under the storekeeper's charge, and he must deliver nothing out unless he receives a requisition similar to Fig. 2, which he must see is properly filled out and signed by the foreman, when he delivers the goods, and, at the first opportunity, fills in the cost and initials the card. These cards are of standard size, 6x4 inches, and are printed on medium quality, buff colored, stout paper, the color being intended to distinguish them from productive order stores requisitions. Besides giving the article wanted,

they must be signed by the foreman, dated, have the department number and section letter (and order number, if necessary, which will be explained later). In this way all stores are distributed to the various departments. Early each morning the boy who goes around collecting cards calls at the storeroom and gets all the previous day's requisitions which will be ready, with the costs filled in. These he takes to the cost-keeper, who has a card cabinet containing two sets of drawers, one set for 6x4-inch and the other for 5x8-inch cards, both standard. One of the 5x8-inch drawers is divided by numbered guide cards (1/1 tab) into as many divisions as there are departments, and again subdivided into the five sections by guide cards (1/5 tab) having the symbol letters A to E on them. Each department will have five active daily material cards in it numbered the same as the department, and with one of the symbol letters on it, as shown by Fig. 3. These cards are of light buff color and medium weight. Suppose that among the store requisitions there is one like Fig. 2—that is an order for some material for department 17A. If there had been no order number (X559) placed in the order number space, the cost-keeper would take the material card out of division 17A and with a dating stamp put the date in the date column, and in the cost column copy the cost, return the card to its proper space, and take up the next requisition, do the same with that, and so on until they had all been entered, with the exception of those having an order number on the top right-hand side, the entering of which will be explained later. At the end of each month the cost-keeper totals up the material cards for each department and puts the results on the material summary card, of which there is one for each department, shown in Fig. 4. These also are buff, medium stout cards, with the five sections shown. The month's summary of the A cards is placed in column A, and the same for B, C D and E, and at the end of the year these are totaled up and grand totaled. The grand total is now carried over to the card shown in Fig. 5 (5x8 inches, white, medium stout) and put down in its own department line, under the material column, and after all the departments have been treated likewise the whole cost is summed up. For the unproductive material we now have the following:

(1) The total cost of unproductive material for each department for the year.

(2) The total cost of unproductive material for each department section for the year.

(3) The total cost of unproductive material for each department for each month.

(4) The total cost of unproductive material for each department section for the month.

(5) The total cost of unproductive material for each department for any day.

THE INCOGNITO CO. LTD.

From 24 - Dec. - 03 Material Dept. 17 A To

Date	Cost		Date	Cost		Date	Cost	Date	Cost	Date	Cost
24 - Dec. - 03	30	18	1 - Jan. - 04		05						
25 - Dec. - 03		13	1 - Jan. - 04	16	32						
27 - Dec. - 03	4	00	11 - Jan. - 04	1	29						
30 - Dec. - 03	1	07	15 - Jan. - 04		03						
			15 - Jan. - 04		03						
			15 - Jan. - 04	10	81						
			16 - Jan. - 04	8	15						
			X559	23	59						
			18 - Jan. - 04	12	51						
Total	35	98	Total			Total		Total		Total	

American Machinist

FIG. 3. DAILY MATERIAL CARD.

THE INCOGNITO CO. LTD.

Material Summary

Year 1904 Dept. 17

Month	A.	B.	C.	D.	E.	Total
January.						
February.						
March.						
April.						
May.						
June.						
July.						
August.						
September.						
October.						
November.						
December.						
Totals.						

GRAND TOTAL

American Machinist

FIG. 4. MATERIAL SUMMARY CARD.

THE INCOGNITO CO. LTD.

Unproductive Cost for Year 1904

Dept.	Material	Labor
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Cost of Material
Cost of Labor
General Expenses
GRAND TOTAL

American Machinist

FIG. 5. YEARLY SUMMARY CARD.

(6) The cost of unproductive material for each department section for any day.

(7) The detailed cost of each article, for any section department on any day, with foreman's and storekeeper's signatures on it.

Note.—As articles are checked out on the storeroom perpetual inventory, they are marked by date, department and section, and so the original store requisition can be referred to at any moment, they being filed away in 6x4-inch card cabinets, in order of date, department and section. Thus all material is authorized and signed for by the foreman, and he is held directly responsible. All costs are made out and initialed by the storekeeper, who is held responsible for the accuracy of the results, and thus in case of error or dispute, *the blame is placed at once.* This has all been accomplished with a minimum of copying and of clerical labor.

We will next follow the unproductive

labor cost, starting with orders from the superintendent or assistant superintendent for repairs, plant additions, etc.

Let us suppose the superintendent wants a small special power press, for which he gives instructions to the draftsman, who makes the necessary drawings and, after deciding the location of the new machine, he makes out an order to the foreman of the machine shop, as per Fig. 6, which is on stout white paper of standard size, 5x8 inches. In the upper left-hand corner he stamps the order number by a numbering stamp, which stamps the numbers in duplicate and then advances one. In front of the number the letter X is placed, to prevent confusion between these orders and other orders connected with the productive part of the business. The letter X is used because it is quick to write and not likely to be mistaken for anything else. The desired date of completion is entered in the lower left-hand corner. To aid in fixing this, all uncompleted orders will be found in the card cabinet under the proper department number, and on the backs of the cards the amount of time already spent upon them. The orders are made out in duplicate by using carbon paper, the form for the duplicate being like Fig. 6, except for the absence of the blank for the foreman's signature. The back is different, however, as will be explained later. These cards are padded by the Johnson process, and the cementing is at the bottom edge, so that the rough edges will not cause them to stick together when looking through the cabinet. They are turned over to the cost-keeper, who sends the original to the foreman, and the duplicate is put in the proper department division in the card cabinet. Before putting it away the cost-keeper copies the outline of the work on the list of orders form, shown in Fig. 7, of white, medium stiff card, 5x8 inches, with department number and date of issue. This serves as a cross index, and also shows at a glance all orders that have not been returned by the unfilled space in the returned column. These cards are kept in the active card drawer till they become filled, after which they are transferred to the inactive drawer. The inactive drawer is divided and sub-divided, and is otherwise exactly similar to the active drawer. Transferring a filled card to the inactive drawer relieves the active drawer of a lot of dead cards.

THE INCOGNITO CO. LTD.

Order No. X 559 Dept. 17 A Date 19-Dec.-03

Mr. W. Johnson,

Foreman of: Machine Shop

Build small power press, as per blue prints #1063 & #1064.

Erect in #17 A. Dept, in marked space at end of #4 Drilling machine.

Supt, E K. Bolton,

Wanted by, 29-Jan -04 Foreman, W. Johnson, Completed, 19-Jan -04

American Machinist

FIG. 6. ORDER FROM SUPERINTENDENT TO FOREMAN.

The foreman, upon receiving the order, makes out a requisition upon the storeroom for the necessary materials, or those needed first, and places the order number (X559) on it, and begins work when the material arrives. Every man working on unproductive labor is required to fill out a daily time report, shown in Fig. 8, which is printed on white, medium stiff paper, 5x8 inches; thus charging his time to the proper departments and jobs. He does not fill in the rate or cost on this card, and must enter only his unproductive time, in case he works part of the day on production. It has been found that the best time for the men to fill in their reports is the first thing in the morning of the following day, when they have clean hands and are not rushing to get home. These cards are turned over to the foreman, who checks and signs them, and afterwards are collected along with others by the boy

THE INCOGNITO CO.LTD.

List of Orders

Order No.	Operation	Dep.	Sec.	Issued	Returned
× 553	New 26" pulley, Main Shaft	12	B/	15-Dec.-03	16-Dec.-03
× 554	New shaft for #8 planer countershaft	12	B.	15-Dec.-03	17-Dec.-03
× 555	Repair roof of #21 Dept,	21	D.	16-Dec.-03	18-Dec.-03
× 556	Adjust valve, #1 Engine, See indicator card	4	B/	18-Dec.-03	20-Dec.-03
× 557	Put new door between #46 & #19 Dept	19	A.	18-Dec.-03	20-Dec.-03
× 558	New radiator, Dept. #8	8	A.	19-Dec.-03	
× 559	Build and erect small power press, B/P 1063 1064	17	A.	19-Dec.-03	29-Dec.-03
× 560					
× 561					
× 562					
× 563					
× 564					
× 565					
× 566					
× 567					
× 568					
× 569					
× 570					
× 571					
× 572					
× 573					

American Machinist

FIG. 7. ORDER LIST.

THE INCOGNITO CO. LTD.

Serial No. 50064 Daily Time Report,

Check No. 26 Name W. Robinson Date 20-Dec-03

Hrs.	Min.	Operation	Dep.	Sec.		Cost
2	00	Testing and measuring castings	x 559		25	13
1	00	Repairing #16 machine.	17	B.		25
3	00	Adjusting #13 Machine	20	B.		75
3	30	Putting new bearing in #2 machine	6	B.		87
	30	Regrinding Valve	12	C.		13
10	00				2	50

Each employee to fill out one of these forms every day.

Approved W. Jonhson Foreman

American Machinist

FIG. 8. DAILY TIME REPORT.

who makes his rounds every morning and who takes them to the cost-keeper; but we will follow the method of entering these later.

It often happens in making repairs that some material is found on the scrap heap or old pieces are used which will not show up on a stores requisition, and so no cost would appear for them. To provide for this, the back of the order form is spaced for material not obtained by a stores requisition, as shown in Fig. 9. The foreman makes these entries for the material thus used, together with the gross weight, and afterwards the weight of scrap, which is in the form of turnings, etc. A certain price is put on old metal, also on the scrap, and this cost is left to be figured out by the cost-keeper. As soon as the job is completed, the foreman dates

COST

Serial No.	Cost	Serial No.	Cost	Serial No.	Cost
Total		Total		Total	

Material

Date	Cost	Date	Cost	Date	Cost
Total		Total		Total	

Material Cost
Labor Cost
Expenses
Cost

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FIG. 10. REAR SIDE OF DUPLICATE ORDER FORM.

the order form, signs it and then returns it to the superintendent's office.

When the daily time reports come to the cost-keeper, he takes the first one, and with a numbering stamp (which by moving a lever will either number consecutively or repeat) he stamps the next serial number in the proper place, on the upper left-hand corner, and then puts the man's rate in the rate column, and, with one of the circular wage-calculating machines, works out the cost of each job, which he can do about as fast as he can write the figures down. Next he takes the first job, which in this instance is two hours on order number X559, department 17A. The back of duplicate of Fig. 6 is marked as shown in Fig. 10. He takes this card from the department 17, section A division, of the drawer, which he has at his right hand, and with the numbering stamp stamps the same number in the first serial number space, copying the cost in the cost column, replaces this card back in its proper place and takes out the 17A labor card, this being the next job. The labor card, of white, medium stiff stock, is shown in Fig. 11, and is filled in in the same manner, the serial number being repeated. All jobs are entered in this way

NOTICE

Put on this form, list of Material which is not obtained by a Stores Requisition

No	Material	Where used	Wt.	Scrap	Net	%	Cost
1	Old shaft,	Countershaft for press,	40	10	30	3	11 6
	Cast Iron	Die Holder,	35	20	15	2½	6 3
	Tool Steel	Shear Blades,	20	4	16	10	19 2
						Total	37 0

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FIG. 9. REAR SIDE OF FIG. 6.

on the various cards, the number of jobs done per day by one man will vary from one to three or four, and after stamping the last one he pushes the lever of the numbering stamp, causing it to advance one, and then proceeds with the next time report in the same manner, and so on until he is through.

The distribution of material has already been explained, except the stores requisition for the X order numbers, which are simply entered on the back of the order card, Fig. 10. If the labor or material list should be extra long and fill up all the space on card No. 10, the cards No. 11 or No. 3 will be brought into use, and the cost continued.

When the foreman returns the order form, Fig. 6, the cost-keeper knows the job is finished, and places the date in the returned column of Fig. 7, and after figuring the cost of materials shown on the back thereof, he puts this on the cost card, Fig. 10, sums up the material and labor, putting the totals in the proper space at the bottom. To this is added the percentage for general expense, the total of which gives the cost of that particular job. Next the labor cost is copied on to the labor card, Fig. 11, and the material cost on to the material card, Fig. 3, so the costs will go on with the rest for the year's total.

Cost cards are only made out by the superintendent or his assistants on important repairs or experiments. For small sundry repairs it is only necessary for the foreman of any department to send an order to the master mechanic. The foremen will not write unnecessary orders, for they know that the cost will appear against their department.

The boy in collecting the daily time reports goes first to department 1, then to department 2, and so on, and thus brings the reports to the cost-keeper arranged in the order of department numbers. As

THE INCOGNITO CO. LTD.

From 11 Dec. 03 Dep. No. 17 A To

Serial No.	Cost	Serial No.	Cost	Serial No.	Cost	Serial No.	Cost	Serial No.	Cost
49969	1 18								
49904	2 56								
49943	35								
499.6	15								
49954	1 18								
49473	2 08								
50479	2 48								
X 559	62 70								
Total		Total		Total		Total		Total	

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FIG. 11. LABOR CARD.

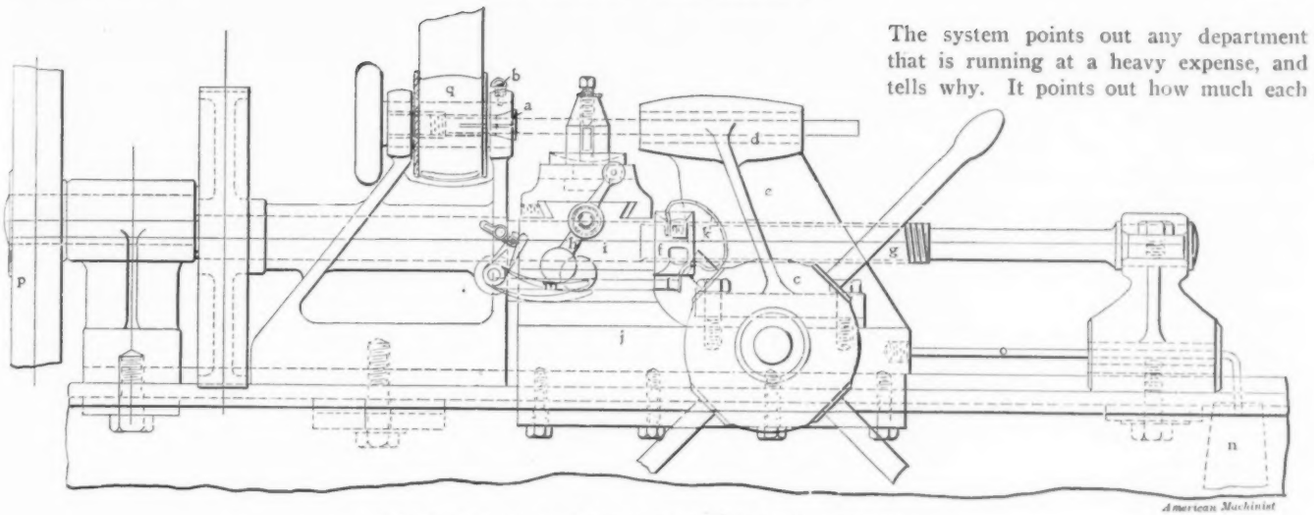


FIG. 1. SPECIAL LATHE FOR RECESSING SMALL SHAFTS.

The system points out any department that is running at a heavy expense, and tells why. It points out how much each department is costing for plant additions, for repairs to machinery, to steam and light plants, to buildings, and the cost of general labor, cleaning, oiling, etc. It points out who is to be blamed for excessive cost. It points out the cost of all important repairs and all experiments. Any cost can be had for any month, day or year, of any department or section. In fact, the cost is given in nearly every way one could wish to have it, and it also affords an accurate basis to determine the percentage of unproductive to productive cost, which in itself is worth all that the system costs.

the cost-keeper takes the top card first, he gets department 1 first, and, as he finishes with them, he turns them over one on top of another, and when he is through he has only to pick the bunch up and put them in their special drawer behind the previous day's cards, the time reports being thus automatically filed in order of numbers, in order of dates, and each day is in order of departments, which makes reference a very easy matter. At the end of each month the labor cards are all totaled up and entered on the labor summary card, similar to the material summary card, Fig. 4, of white, medium stiff, 5x8-inch stock, in a similar way on the material summary card, Fig. 4. At the end of the year these are totaled up, grand totaled, and entered on the year's unproductive labor cost card, Fig. 5. The cost of material is added and put at the space at the bottom of the card, the cost of labor is added and put in space under material. Under this is added the percentage for general expense. The lot is then totaled, giving the actual cost of unproductive labor and material for the year.

The advantages of this system are numerous. From the cards we can get the cost of material or labor, for any department or for any department section, for any day, month or year, and can compare the cost for one department or department section against that for others for any month. Any expense for material or labor can be analyzed at once, and each cent accounted for on the original cards, which are signed by two men, and these cards can be located without any search, as they are filed in order of dates and numbers.

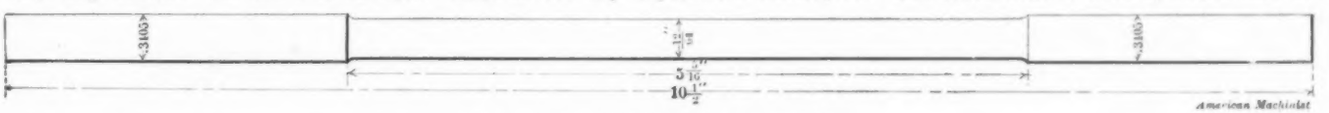


FIG. 2. THE SHAFT TO BE RECESSED.

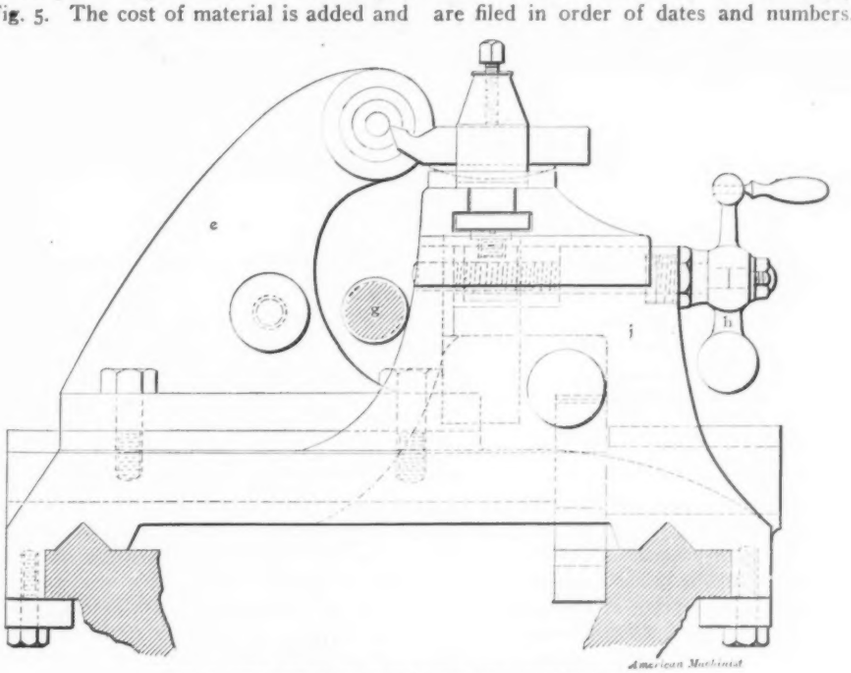


FIG. 3. SIDE VIEW OF SLIDE-REST AND STEADY-REST.

Special Lathe for Recessing Small Shafts.

BY H. ROBINSON.

Fig. 1 is a front view of a specially designed lathe for recessing small shafts between their bearings, the shaft being shown in Fig. 2. The advantages which this type of machine has for this purpose over the usual lathe are: obviating the necessity for centering the shafts, eliminating to a great degree the springing of the shafts, semi-automatic action, simplicity of construction and ease of manipulation.

One end of the shaft is gripped in the spring chuck *a*, Fig. 1, the spindle being held stationary when tightening the chuck by the spring pin *b*. When the pilot-wheel *c* is moved forward the projecting end of the shaft enters the bushing *d* in the steady-rest *e*. The split nut *f* having been closed upon the feed screw *g*, the handle *h* that adjusts the cutting tool in and out is moved until it comes up against the stop-pin *i*. The forward motion of the slide-rest *j* moves the belt shifter and starts the machine, and the tool continues recessing the shaft till the spring *k*, which holds together the split nut *f*, comes up against the knock-out pin *l*, which trips

the spring *k* and opens the split nut. Just before this operation takes place, the slide-rest *j* acts on the hinged lever *m*, thereby moving the handle *h*, which in turn withdraws the cutting tool. The clutch having been opened, the slide-rest with the steady-rest on it is moved back automatically and quickly by the weight *n* attached to the cable *o*, the end of which is fastened to the slide-rest. The backward motion of the slide-rest acts also on the belt-shifter, stops the motion of the machine and the finished shaft is taken out.

Fig. 3 shows a side view of the slide- and steady-rests, with the tool in position, which, however, may be a circular cutter with an unadjustable holder, obviating the necessity of setting it every time it is ground. The machine is driven by two belts, one of which drives the pulley *p*, which is connected by gearing to the feed screw. The other belt drives the small pulley *q* which turns the shaft.

The Schuberth Automatic Profile Lathe.*

The exact and economical production of profile parts on the lathe is at present carried out by means of profile tools or with a templet and an ordinary lathe tool, and only in individual cases, as in turning arched pulleys or in finishing hand-wheels, is any other method employed.

Profile tools are most advantageously used for small work. With large work they can only be used on a small section at a time and the frequent changing of tools makes the work slow and expensive. For large work it is therefore customary to use an ordinary tool and work to a templet.

Many parts which are often repeated, such as connecting rods, crossheads, pistons, cylinder covers, etc., must be turned up by hand. This disadvantage is overcome by the Schuberth system profile lathe, illustrated herewith, which will turn a profile of any length or shape. The templet has the shape of the profile to be turned and the feed is arranged so that the tool advances uniformly, the distance being measured on the outline of the profile. No errors can be made in copying because the tool and the guiding pin are rigidly connected and must make the same movements. The guiding templet can be disconnected and the lathe used for ordinary work.

Fig. 1 shows a perspective view of the lathe, of which the headstock and tailstock are of the usual design. The rest is, however, of novel construction. Its motion is derived from the headstock by means of an eccentric and a special ratchet-wheel drive. Figs. 2 to 4 show the front elevation and sections of the rest. Fig. 5 shows a horizontal section, and in Fig. 6 is shown the guiding templet. The small gear wheel *a*, Figs. 3 and 6, is a part of the rest and moves it to follow the outline of the templet.

The operation of the rest is as follows: The eccentric seen in Fig. 1 on the end of the headstock gives the grooved shaft *b*, Figs. 2 to 6, an alternating rotary movement, the amount of which can be regulated by altering the point of connection of the eccentric rod with the lever on the end of the shaft. The motion of the shaft is transmitted through the gears *c* and *d*, Figs. 3 and 4, the shaft *e* and the other connections shown to the bell crank *f*, which carries a spring bolt *g* which can engage in the ratchet wheel *h* to produce the feed. If the bolt *g* is lifted and turned through 90 degrees it is disengaged, and if turned through another 90 degrees it engages with the ratchet wheel and drives it in the opposite direction. This ratchet wheel *h* is rigidly connected to the shaft *i* so that when it is moved it drives the worm *j*. This worm slides on the shaft *i* but is driven from it by two spring keys, and is always in mesh with the worm wheel *k*, which drives the vertical arbor *l* and the small pinion *a*. This pinion meshes in a sort of curved rack *m* formed by pins arranged around the outside of the templet, as shown most clearly in Fig. 6. The rotation of the pinion carries the guide pin *n* along the groove in the templet *o* and through the bearing of the arbor *l* carries with it the slides *p* and *q*. The lower slide *p* moves only back and forth along the lathe bed, while the upper slides move transversely in accordance with the profile of the templet. The slides *r* and *s* serve only to adjust the position of the tool. It is obvious that all points of the slides *p q r s* and the tool carried by *s* must make precisely the same movement as the guide pin *n*.

At the right-hand side of Fig. 1 is shown the same templet as in Fig. 6, and beside it the connecting-rod head turned to it. The other piece on the left is a roll having the standard tire section of the Saxon State Railways and the corresponding templet.

If the machine is to be used as an ordinary lathe, the templet is left off and the necessary feed is connected up. To avoid the wedging action of the grooved shafts, they are carried in spring bearings.

The rack *m* is made of smooth steel pins which can carry over 2 tons pressure, so there is no fear of breakage. As the templets do not sustain any great pressure they can be made of cast iron.

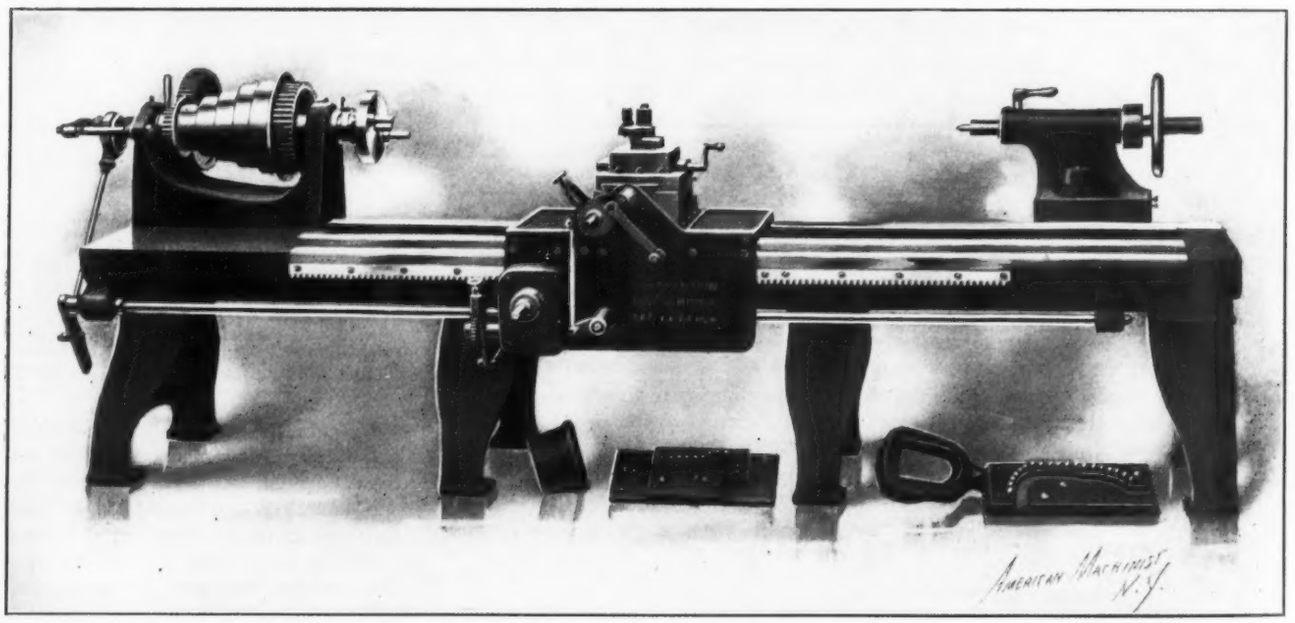


FIG. 1. A GERMAN AUTOMATIC PROFILE LATHE.

*Translated from German by Lawford H. Fry.

On an electric railway in Colorado the passengers pay by weight [why not?]. The rate is 1½ cents per pound for a ride of 17 miles.

Old-Fashioned Time-Keeping.

Eben Gould is writing in the *Textile World Record* some interesting reminiscences entitled "Memoirs of a Veteran Master Mechanic," from which we take the following:

When I first went to work at the Madderkirk Mills, they had rather a strange way of keeping the working time of the help. Each man in the shop kept his own time, and once a month the paymaster would come round and get each one's time from him and ask him how much money he wanted; they settled up only once a year. After getting each man's time, the paymaster would come around in a few days and pay the money called for, the balance being carried over until the yearly settlement.

I thought that it was a queer if not a foolish way of keeping time and one likely to cause trouble, especially if anyone was disposed to make trouble. To avoid any misunderstanding about my time, I got a book in which I kept a note of the hours of my week's work and of all my time nights and Sundays. Then on every overtime job I would write down the job on which I worked, how long it took, and the names of the men who worked with me, thereby being able to prove every hour I had worked. At the end of each month I gave in the number of hours altogether. No one knew that I kept a journal of all my work.

Well, time went on and no question of time came up until during the first year of the civil war, when the mills began running night and day; then the overtime began to come in very heavy.

It was during the month in which I moved the old engine from its bed outside the mill and set it up so as to keep everything going until the new engine was ready to start, that I had to extend the shafting to five different lines of shafting running through the new mill that had just been added. Each of these lines had to have one 16-foot length taken down, and a coupling fitted on it; it was then put up and belted to the new shaft. All this had to be done Saturday night and Sunday, and was all done ready to start on time Monday morning.

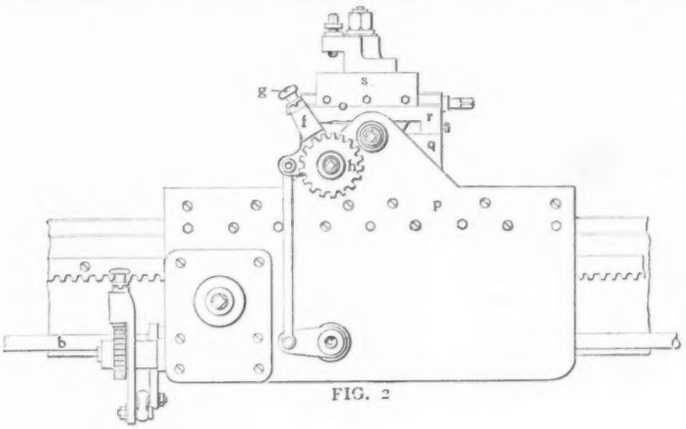


FIG. 2

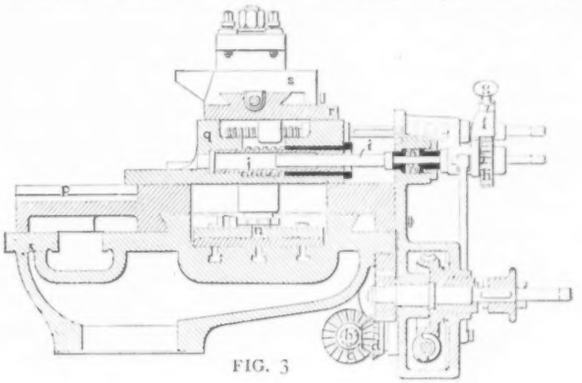


FIG. 3

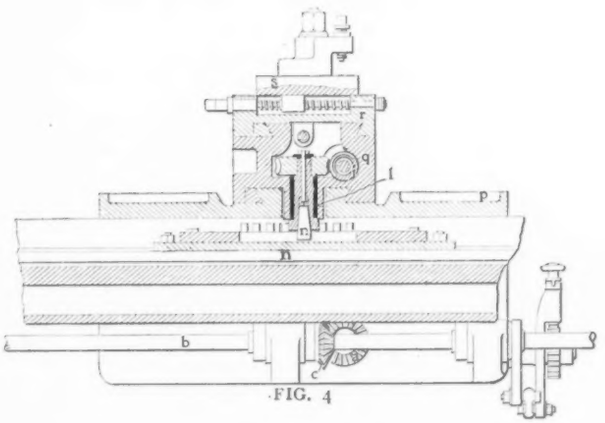


FIG. 4

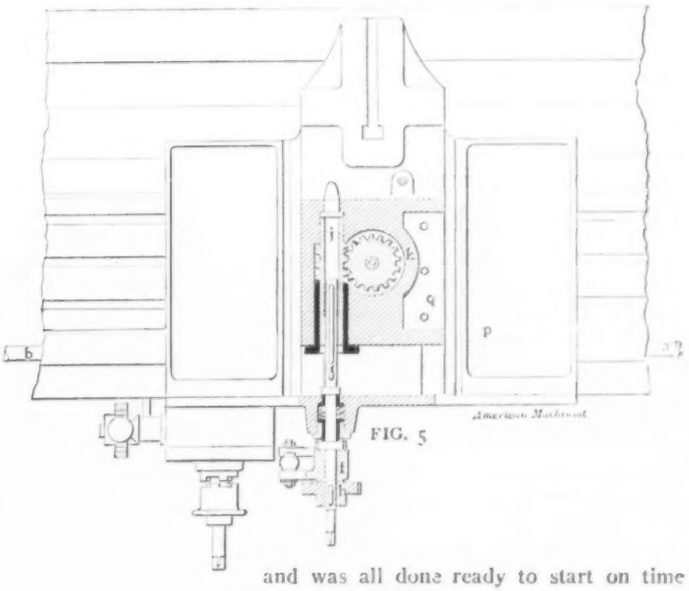


FIG. 5

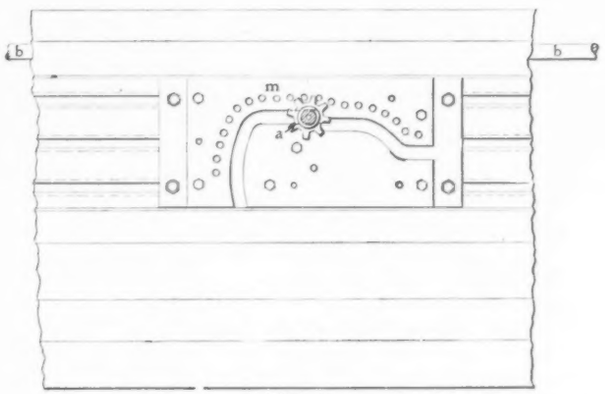


FIG. 6

DETAILS OF PROFILE LATHE SLIDE-REST.

Besides this extra work, one of the big Philadelphia cloth presses broke down; this press had to be taken down and new screws and gears put in and set up.

All these jobs were ordered personally by Mr. Twitcher, and when done, he had expressed himself as being well satisfied, saying he did not think I could get them done in time to start.

At the end of the month I could see that trouble was brewing. I gave in my number of hours for the month, which was the largest month's work I ever did. Several days later Mr. Twitcher came to me and said:

"You have been giving in more time than you worked and I won't pay it."

"Oh, yes you will, Mr. Twitcher," I said, "you will pay every cent of it."

"No one could work that number of hours in one month," he said.

"I agree with you that no one ought to

work so many hours," I replied, "but, Mr. Twitcher, I have not charged one hour's more work than was done or that you did not order yourself, and about which you did not express yourself as being well satisfied. I can tell you of every hour's work I have done since I first came to this mill. I saw from the first that one was liable to get into trouble, and I have kept an account of every job I have done, who worked with me, and can prove all my time, and you will pay every cent of it, and I know you will be glad to do so."

"Well," he said, "I should like to see your account."

I offered him my book, but he said:

"I only want you to copy off last month's time and give that to me."

"All right," I said.

I knew very well that some stuff had been talked to the new paymaster, as there were all sorts of stories circulated about my cheating in time, and that I had not made any deduction for any day time when I had been away, the others supposing that I had done as they did, not keeping an account of every hour day and night.

About four hours after his talk with me, Mr. Twitcher came in the shop as pleasant as could be. I handed him a sheet of paper, saying: "Mr. Twitcher, you look over that account, and tell me what you think of it."

He took the paper and left the shop without saying anything further. I did not hear anything from Mr. Twitcher during the month, but I did hear that the paymaster had told several parties that Mr. Twitcher was looking for a man to take my place, and as soon as he found one I should have to go. I kept quiet and did not say a word to anyone, but could not understand why Mr. Twitcher did not speak of the matter. He came every day to the shop, and was as pleasant as anyone could be, but he only spoke about the work.

On the first day of the following month, after the time had been given in, one of the old stand-bys came to me and asked me if I could tell him all the time he had worked with me, but none of the other time. So it went on for a week, when Mr. Twitcher came in, went up to the man who had been so anxious about his extra time, said something to him and went out immediately. I never saw anyone's jaw drop as that man's did. He looked as if he was stunned.

"What is the matter?" I asked.

"Discharged," he replied.

That took me back a little, for I did not know what was the cause of it. Several hours later Mr. Twitcher came into the shop and said:

"I want you to keep the time of all the repair hands, carpenter, blacksmith, engine and boiler men and all the outside men. I like your way of keeping time; it gives a great deal more satisfaction when you can tell what you have done."

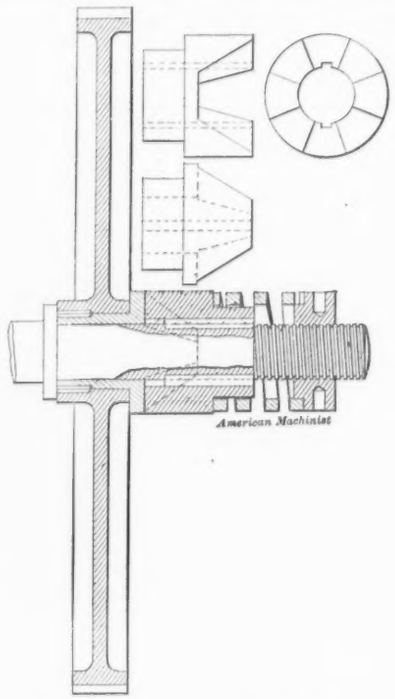
"Mr. Twitcher," I said, "it is reported all over the village that you were looking for a new man and that I had to go."

"No such thing," he said, "I only gave those that said you had not set down your time while out the same test I gave you, to bring in what they had been doing during the last month, and they could not account for one-half of their extra time. Three years ago they reported stories about you to me, and got us into a misunderstanding, which you cleared up in a few words, and then I told them if they ever got us into any more trouble they would have to go. This man was one of them, and now he is gone and will not be here to bother us again."

After this Mr. Twitcher was as pleasant a man as I could wish to work for.

Cushioning Device for Planers.

According to *The Mechanical Engineer*, of Manchester, Messrs. Smith & Coventry, of that city, have taken out a patent on a cushioning device for planers, which is illustrated herewith. The wheel is loose



CUSHIONING DEVICE FOR PLANERS.

on the shaft which it drives through the medium of the interlocking clutch shown. The faces of the teeth of this clutch are not axial planes as usual, but are helices, the angle of which is such that when the wheel is reversed the clutch slips more or less, such slipping being resisted by the heavy helical spring which may be adjusted to give any required pressure by means of the threaded collar at the right. Our contemporary states that the object of this is to absorb the shock of reversing the heavy platens of planers, but according to articles we have published the most of the work required to be done in reversing planers is expended upon the rapidly running pulleys and very little of it indeed upon the platen.

New Patent Law of Mexico.

A full translation of the new Patent Law of Mexico is given in a recent issue of *Consular Reports*. It contains a number of provisions more or less novel and which are at least deserving of consideration in this country. The following extracts are clear and entirely self-explanatory:

The following are patentable: A new industrial product; the application of new means to obtain an industrial product or result; the new application of known means to obtain an industrial product or result.

The owner of a patent has the exclusive right: To exploit it, for his own benefit, during the term allowed by this law, either personally or through others with his permission; to prosecute before tribunals those who infringe upon his right either by the industrial manufacture of the patented article or by the industrial use or employment of the patented process or method, or who for a commercial purpose keep in their possession, offer for sale, sell, or introduce into the national territory, one or more of such articles manufactured without his consent.

The patent produces no effect: Against similar objects which in transit pass through the national territory or tarry in its territorial waters; against a third party who was already exploiting the same patented object in the country prior to the date on which the patent application was presented or who had made the necessary preparations to exploit it; against a third party, who, for experimental or studious ends, constructs an object or conducts a process which is the same, or substantially the same, as that patented.

The Patent Office will make a purely administrative examination of the documents presented in order to ascertain whether they are complete and whether they satisfy the requirements of form laid down by the respective rules of practice. In consequence this examination *will on no account turn upon the novelty or utility of the object sought to be patented nor upon the sufficiency, clearness and exactness of the documents.*

In case the Patent Office is satisfied with the regularity of the documents presented, it will, by means of a notice, inform the interested party to that effect. The legal date of a patent is the date of the legal presentation, at the Patent Office, of the petition and documents which constitute it, and from that date it is supposed to have been granted and produces its legal effects, save as provided in the following article.

The legal date of a patent, solicited in Mexico and already applied for by the same person in one or more foreign states, will be that appertaining to the foreign patent first applied for, provided that it be applied for in Mexico within twelve months counted from the date of the first patent application abroad, in the

case of a patent of invention, or within four months from the same date in the case of a patent for an industrial design or model, and provided also that the foreign state in which the patent was first applied for grants the right to citizens of Mexico. In consequence all patents applied for in Mexico under these conditions will have absolutely the same force and will produce the same effects as if they had been applied for on the day and hour of their legal date.

Patents will be granted without prejudice to third parties and without guaranty as to their novelty or utility. Their issuance only constitutes a presumption as to those qualities and of the rights of the holder, until the contrary is proved.

Patents of invention are granted for a period of twenty years, counted from their legal date. This period is divided into two—the first of one year and the second of nineteen years. The tax for the first period of one year is $5. The tax for the second period, or for the remaining nineteen years, is $35. The payment of all these dues will be effected strictly in stamps of the federal stamp revenue in the form provided by the rules of practice.

The period of time may be extended for five years longer, within the discretion of the Executive, subject to the payment of the additional dues which said Executive may see fit to fix.

He who desires to obtain the concession referred to by this article must address a petition to the Patent Office within the penultimate half-yearly period of the ordinary term of twenty years. He must also prove that the patent has been in uninterrupted industrial exploitation in the national territory for at least the last two years immediately preceding the date of his application.

The exploitation of a patent is not obligatory; but if after the expiration of three years, counted from its legal date, it is not exploited industrially within the national territory, or if after the expiration of those three years its exploitation has been suspended for more than three consecutive months, the Patent Office may grant to third parties a license to effect said exploitation.

Any person desiring to obtain a license such as referred to in the foregoing article will have recourse to the Patent Office, setting forth the reasons or grounds whereon he bases his petition. This petition will be referred to the owner of the patent and an unextendible term of one month will be given within which both sides may present to the office such proofs as they may deem expedient. Within that same period the office will be entitled to ask for information, to appoint inspectors and in general to do everything which, without departing from its character as an administrative authority, it may consider expedient to do in order to ascertain the true facts. When the owner of the patent in question shall not prove that he has commenced industrially to exploit the object of said patent in accordance with the provisions of the article, no evidence on his side will be accepted, but forthwith and without allowing the period for proofs mentioned in the foregoing article the license requested will be granted to the applicant. Within fifteen days, counted from the expiration of the period for the rendering of proofs provided by the article, or within eight days, counted from the presentation of the application for license under the terms of the foregoing article, the Patent Office will decide as to whether the license asked for is or is not to be granted.

A party in interest who is not conformable with this resolution will be entitled to have recourse to either of the district judges of the City of Mexico, with a view to the revocation of said resolution, acting in the capacity of plaintiff, while the other interested party will act as defendant, the former being obliged to present his suit within the unextendible term of eight days, counted from the date whereon the administrative resolution is communicated to him, with the understanding that, if he does not so present his suit, he will be considered as having desisted from this action and as conformable with the resolution in question.

The effects of the administrative resolution granting the license asked for shall not be suspended because the owner of the patent has had recourse to the judicial authority; so that the person who has obtained the license is entitled to exploit the patent at once without the obligation of giving a bond or of complying with any other requirement.

The person who has obtained a license of the kind in question will be obliged to begin the exploitation of the patent within a period of two months counted from the date of the resolution, if said resolution was handed down by the Patent Office, or from the date of the legal notification thereof, if the resolution was dictated by a judicial authority, and must not suspend said exploitation for more than two consecutive months.

One-half of the net earnings obtained by the owner of a license as the result of the exploitation will belong to the patentee, who, therefore, will be entitled to exercise vigilance over said exploitation and to demand, judicially, if necessary, the payment of that half.

The provisions of this article are without prejudice to any agreement or agreements into which the parties concerned are entirely free to enter. In case the owner of the patent is absent or fails to present himself to enforce his rights, the owner of the license will be obliged to deposit every two months the half of the profits referred to in the foregoing article in such bank or institution of credit as shall be designated to him by the Patent Office, and, moreover, he must keep that office informed as to the proceeds of exploitation and the net earnings by means of bimonthly reports. Failure to comply with the requirements of this article will cause the Patent Office, at the request of the owner of the patent, to revoke the license granted.

The licenses that may be granted in accordance with the foregoing articles by the Patent Office do not deprive the patentee of the right of exploiting the invention himself and of granting such licenses as he may desire. The patentee is entitled to ask for the revocation of a license granted by the patent office when, after two years from the granting of the license, the owner of the patent, or any other person in his name, shall be exploiting the patent industrially. The indispensable requisite for the taking into consideration of the petition in question is a demonstration on the part of the patentee to the Patent Office, that the exploitation has been initiated; for otherwise the petition will be forthwith rejected, and against this resolution there shall be no recourse.

It will also be an indispensable condition for the acceptance from a licensee of proofs that he has initiated the exploitation within the period of two months allowed him by the law, that he shall, within the proper time, have forwarded to the Patent Office the evidence alluded to.

A patentee is entitled to prosecute before the tribunals as an usurper of his patent, or as an illegal operator thereof, the holder of a license granted by the Patent Office who has not commenced the exploitation of the patent within the period of two months allowed, or who has suspended the exploitation for more than two consecutive months, and who nevertheless shall be exploiting the patent, save in the event of the suspension having been due to a fortuitious contingency or to force majeure.

Both the patentee and the person to whom the Patent Office shall have granted a license for the exploitation of the patent are under the obligation, when they shall have commenced said exploitation, to afford evidence thereof in any legal manner to said office within a period of time not exceeding fifteen days.

Correspondence Instruction in Indicator Practice.

Under the name of the Indicator Instruction Company, of Scranton, Pa., Mr. A. C. Lippincott, who is well known to all steam engineers, has organized a school of correspondence instruction in the use of the steam engine indicator, including reducing motions and planimeters. These instruments will be loaned to students for purposes of instruction and tests are to be made and reported in the instruction papers showing the damage to instruments due to maladjustment and wear.

The New Tool Steel and Its Effect on Machine Shop Methods.*

Manufacturing, in the modern and best sense of the word, has, we may fairly say, had its birth in the last half of the nineteenth century. For the past forty years or more there was a well-defined discontent among men of progressive ideas with the methods in vogue and the results obtained in general machine shop practice. The opinion prevailed that the product of none of the machines in use was up to a standard commensurate with their cost and maintenance. What should the remedy be? As so often happens in such instances, some invention was sought for which would be revolutionary in character, and which never comes. Many suggestions were made; some of them wise and some otherwise. Of the latter class I may mention the abrading wheel to grind off the stock, and the cold saw to tear it off, in place of the cutting tool to pare it off, as it was and is used with all of the machine tools.

In the early days, while we were making things, and before we had learned how to manufacture, the lathe was the all-around tool of the shop, and it was made to do much work which could have been more expeditiously done on a surfacing machine, which then was not in existence. But with the demand for it the planer soon came forth, and it was followed by the shaper and the milling machine. As these tools came into general use, the necessity of further increasing the product and reducing the cost again became pressing, and it forced the process of segregation on until we were given the screw machine, the turret lathe, the boring mill, the pulley lathe and the automatic gear cutter. All of these tools were made heavier and larger year by year until their limit of production was reached, not on account of the machine itself, but on account of the tool steel then to be found in the market. I am not so sure that this steel was wholly to blame for some of the failures which are charged against it, but suspect that a part of them at least were due to lack of knowledge in handling. It was a fact, nevertheless, that in many of the new machines the steel would not stand up to the larger demands put upon it, and so a blank wall seemed to rise up and bar further progress, which to a certain extent it has controlled for the last quarter of a century. Some increase in the output of these machines was obtained by the use of cooling mediums, such as water, oil and alkaline solutions, which were allowed to flow on the tools at the cutting points and so carry off some of the heat, and this practice still obtains in some lines of work.

In the efforts to increase the product of the machines as they became more powerful, they were driven at higher speeds, with greater depth of cut and faster feeds, until the heat produced at the tool point caused it to break down, and it was found that the limit of temperature for the carbon steel was from 450 to 500 degrees.

In the early practice, to harden steel for tools, we were instructed to heat it to "a cherry red," cool in water, clean off the hardened surface, and again heat until by oxidation the light color was succeeded by shadings from a light yellow to a dark blue, this color indicating a low temper. That the "cherry red" temperature, as measured by the eye, was a very large uncertainty, may at once be suspected. It may well be doubted if any two persons could measure it alike within a hundred degrees, and the same operator could not do it on two different days if one were clear and the other cloudy. This feature has come to be so well recognized in the large establishments where much hardening and tempering is to be done that a room is provided for it with curtains on the windows, so that a uniform light shall be secured. It used to be thought necessary to make the steel harder than was required for any particular service, and then reduce it as before described. The later and better practice is to use a lower hardening temperature, thereby avoiding the second process, and I think there need be little doubt that from 10 to 15 per cent. more work might have been obtained from this steel had we better known how to handle it at the forge.

With all of the desire and effort on the part of the manufacturing world to increase the output of the tools in use, it is a curious fact that it allowed a new steel to lie within its grasp for nearly forty years without recognition of its value, and which, if properly used, would have increased its product from 25 to 40 per cent. The new product was known in the market as Mushet steel, being named after the inventor. Mushet was an Englishman who lived in the Forest of Dean, a locality where much of the charcoal used by the Sheffield mills was made. With the aid of a steel-maker named Brookfield he produced the new alloy which was said to contain 2 to 3 per cent. of carbon, and 8 to 10 per cent. of tungsten. The first alloy of tungsten and iron dates back to 1773, and d'Elhuyar & Beirthier are accredited with its production; but at that date it attracted no attention in the industries.

There are two reasons why this steel did not get into extensive use at an earlier date: one, its cost was 40 to 45 cents per pound as compared to the carbon steel at 6 to 20 cents. The other reason, and by no means the least, was due to the great difficulty in forging it to the required shapes, for if not heated and forged properly by the blacksmith it would break and go to pieces as easily as cast iron.

A striking characteristic of the tungsten steel was that it did not have to be hardened; it was always hard when cold, and it could not be annealed. It, however, possessed that quality of structure which enabled it to stand from 600 to 700 degrees of temperature before it would break down. This new steel came later to be known as self-hardening steel, and as air-hardening steel, from the fact that if subjected to an air blast its lasting qualities were enhanced to a small degree. The usual surface velocities at which the carbon steel was used varied from 15 to 25 feet per minute, while the tungsten steel would stand from 40 to 80 feet.

On a fractured surface the tungsten steel shows a very close structure; it is darker in color than the carbon steel, and in grinding on an emery wheel it gives off a dark-red spark like cast iron, while the other grade shows a bright and scintillating spark. For many years it was supposed that the function of the tungsten was to hold a larger percentage of the carbon in the combined form, and therefore the steel-maker always furnished the toolsmith with positive instruction to work it at a low temperature, and this direction was carefully followed.

Up to comparatively recent dates, all of this steel was imported from England. Finally American manufacturers began to produce it, and while their first attempts were far from successful the American product now is not excelled by any other.

About four years ago a discovery was made which marked a long step in advance in the use of these steels for cutting purposes. Presumably by accident a tungsten steel tool was heated up to the point of combustion or to the melting point. After cooling off it was put in service, and it caused general surprise by showing much higher efficiency than was ever before attained by any steel. This incident was brought to the attention of a couple of young men, one a chemist, the other an engineer in the employ of the Bethlehem Steel Company, who at once began a series of experiments to determine the cause for these unexpected results. So far as it is known this has not been found, but they did discover some method of treatment which is still a trade secret, by which the steel could safely be raised to this high temperature, and still be on a commercial basis. After this new treatment it was found that the tools would stand from 1,100 to 1,200 degrees of temperature before failure occurred.

This discovery opened an immense field for improvement along nearly all manufacturing lines, and it also developed the rather astounding proposition, that to get the full benefit of it, all machine tools with which the new steel should be used, must be designed and built especially for it. It was speedily found that none of the tools in use were heavy enough to withstand the extra strain, neither had they sufficient driving power for the increased cuts which the new steel would stand.

That a clearer perception may be had of what this portends, it may be stated that the standard machine tools of average size

*From a paper by Professor C. I. King in *The Wisconsin Engineer.*

require from one to six horse-power to drive them, while new tools already in the market, and designed especially for this steel, have at a maximum used 50 horse-power.

In the series of experiments made at the works of the Bethlehem Steel Company to prove the value of the new process, 200 tons of forgings were used and $100,000 were expended. Many large forgings are made by this company and in their production much time and fuel are required, and many men are necessary to handle them; by the old method these forgings were brought as nearly as possible to finished sizes before machining; now they are made only to approximate sizes, and the lathe and one or two men do the rest, and forgings of 36 inches in diameter have been reduced to 28 inches at one cut.

As a result of this recently acquired knowledge, line shaft speeds have been increased from 90 to 250 revolutions per minute; cutting speeds are increased 180 per cent., depth of cut 30 per cent., and the rate of feed by 24 per cent., and the end is not yet in sight. The planing machine and shaper will probably be the last of our tools to succumb to the new conditions, but we may not be surprised to see them driven at speeds approaching 100 feet per minute in the near future.

In contemplation of these results the question at once arises: what has caused this wonderful mutation in the structure or chemistry of the alloy? Frankly, no one knows and for the present at least we must be contented with the results obtained. It is known that where the steel contains small percentages of chromium, and carbide of chromium, the last-named element is reduced in quantity by about one-half after the steel is treated. Analyses of what are called the burned portions of the steel showed that nearly all of the carbon had been burned out, and the inference was at once drawn that the carbon was not necessary, and so in the new steels only .5 to .6 per cent. is left in.

It may be of some interest to state that the original Mushet steel, when worked at the cherry-red temperature of 1,450 to 1,550 degrees, gave what was supposed to be its greatest possible service. Between this and 1,700 degrees the value rapidly fell to nearly zero, but from this point up to 1,900 it rises sharply to the maximum. It also has been found that some of the new product can be annealed so that it can be machined, and some of it is soft when sent from the mills; this of course opens up a much larger field for its use, and makes it available for milling cutters, dies, drills, etc. Curiously enough, it will not stand shock and jar, and therefore is not suitable for cold chisels, stone drills or any of that class of work.

It also fails in use for finishing work in the machines, where the carbon steel succeeds. Its greatest success has been found in roughing work, and, without seeing, it is difficult to believe that it will render service after the temperature has risen until both the tool point and the shaving are red.

Apparently the higher the temperature to which the steel can be raised in treating it for use, without melting it, the higher the temperature it will stand in service.

Molybdenum is also used to produce an air hardening steel in place of the tungsten, only about one-half of the quantity in weight being necessary to obtain the same result, and in some of the steels both of these materials are used.

The price of this new product ranges from 50 cents to $1 per pound. The manufacturers state that these high prices are due largely to the difficulty in getting a homogeneous alloy, owing to the greater specific gravity of the tungsten and molybdenum. Neither of these alloys are so efficient in use on cast iron as on the forged stock, yet they excel the carbon product by 25 or 30 per cent.

British Pessimism.

United States Consul Rufus Fleming sends from Edinburgh the following interesting note on British trade conditions:

"One cannot be too careful in estimating the value of opinions expressed by newspapers, trade journals and managers of manufacturing plants. I do not mean that they are intentionally misleading or that there is any other purpose on the part of the press or managers of great works than to say exactly what they think. But the mental habit of measuring conditions in this new century by those of the old days, when British manufacturers had little competition to meet anywhere and profits were enormous, has imparted a pessimistic color to all comment on industry and commerce. The monopoly they long enjoyed at home and in many outside markets having come to an end, the requirement of vaster production at much lower prices to make industries pay renders vivid the memory of the easy-going times of prosperity and gives a distorted view of the existing situation. In fact, the chief apparent danger to British manufacturers in important branches lies in their reluctance to turn away from the past and forget all about it and to face the present and future—face the necessity for bringing their equipment up to date. They have lost ground, and probably will continue to lose ground, for their rivals in the industrial field are formidable; but if they adopt advanced scientific methods in all departments they should be able to hold their own."

We want facts bearing upon the advantage, measured in money, of a good tool-room system as compared with a poor one or none at all. Any reader who has such facts will confer a favor by addressing the editor.

Letters From Practical Men.

Hardening Spring Chucks.

Editor American Machinist:

At page 29 there is shown a fixture for use in spring chuck hardening which interested me, as I have made thousands of these chucks and have had every opportunity to experiment with various methods of handling them. It is impossible to harden a spring chuck and have it retain its shape unless secured in some way; so for small chucks with three slots I make three pieces of sheet steel *A*, Fig. 1, about 1-32 inch thicker than width of slots, and each provided with two small holes, as shown. The edge at *B* is slightly beveled to give the plates an easy start when putting them in place. After the plates are properly located a soft wire is passed through the holes and tied, and the chuck is now ready to harden, the plates prevent-

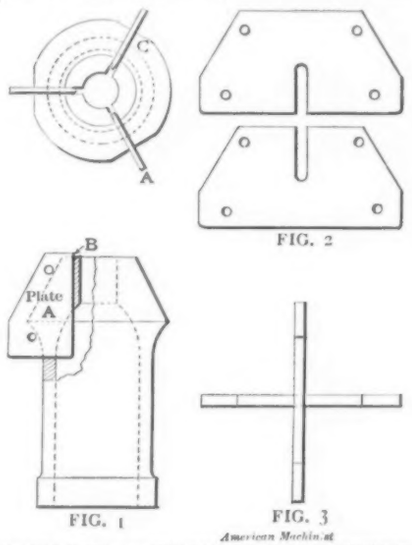


FIG. 1 FIG. 2 FIG. 3

American Machinist

PLATES USED IN HARDENING SPRING CHUCKS.

ing it from closing and the wire preventing expansion, so that there is no guesswork in this operation. After hardening I string the plates and put them away for the future, as they may be used several times. For a chuck with four slots I follow the same method except that I make the plates like Fig. 2 and put them together as in Fig. 3, with the bevel edges at the bottom instead of at the side. These interlocking plates I use only on chucks with large center holes, where the water has a free passage through, as I prefer to have the center hole as clear as possible so that the water can flow all around the hole. To prevent the jaws from acting as a reamer, I flat the edges as at *C*, Fig. 1. Some mechanics look upon this as unnecessary, but I have seen good chucks spoiled by leaving the edges sharp or with the burr just taken off.

G. D.

Symbolic Indexing.

Editor American Machinist:

Apropos of the subject of numerical indexing, I enclose you herewith a sample piece of celluloid, which you will observe

has the alarming index number of No. 10, 1063, YK, 12, DM, 10, 10, 08, 31." It would seem as if this ought to satisfy the wildest advocate of symbolic indexing, and yet I find by referring to the bill for the goods, that, not satisfied with the gigantic symbol shown on the goods, they have billed them as follows: "No. 10 S 1063 A A 2d." Comment seems unnecessary.

ROBERT J. HEARNE.

[The sample sent is a thin strip about 3¼ inches long by about ½ inch wide, so that the symbol comes pretty near being longer than the piece.—Ed.]

Uniform Load in Pounds per Square Foot	1 Inch Plank		2 In. Plank		3 In. Plank	
	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span
40	75	37	151	75	227	113
50	67	35	135	70	203	105
60	61	33	123	66	185	99
70	57	31	114	62	172	94
80	53	30	107	60	161	90
100	48	28	96	55	144	83
120	43	26	87	52	131	78
140	40	26	81	50	121	74
150	39	24	78	48	117	73
160	37	23	75	47	113	71
180	35	22	71	45	107	68
200	33	22	67	44	101	66
225	—	—	64	42	96	63
250	—	—	60	41	91	61
275	—	—	57	39	86	59
300	—	—	55	38	83	58
350	—	—	50	36	76	55

TABLE 1. SPAN IN INCHES FOR LONG LEAF SOUTHERN PINE FLOORS.

Uniform Load in Pounds per Square Foot	1 Inch Plank		2 In. Plank		3 In. Plank	
	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span
40	69	33	138	65	207	98
50	61	30	123	60	185	91
60	56	28	113	57	169	85
70	52	27	104	54	157	81
80	48	26	98	52	146	78
100	43	24	87	48	131	72
120	40	22	80	45	120	68
140	37	21	74	43	111	64
150	35	21	71	42	107	63
160	34	20	69	40	103	61
180	32	19	65	39	97	59
200	30	19	61	38	92	57
225	29	18	58	37	87	55
250	27	17	55	35	83	53
275	—	—	52	34	78	51
300	—	—	50	33	74	50
350	—	—	46	31	70	47

TABLE 2. SPAN IN INCHES FOR WHITE OAK FLOORS.

The Strength of Plank Floors.

Editor American Machinist:

Draftsmen on engineering work may find the following tables useful to add to the tables given in their Cambria or other engineering pocket books. The tables for the strength of wood beams in the Cambria pocket book commence with a depth of 4 inches, so with these tables in addition about everything will be covered.

Each table gives the maximum safe span for 1-, 2- and 3-inch planks under different uniform floor loads running from 40 pounds to 350 pounds per square foot. In the first column, under each thickness of plank is given the maximum span in inches, not considering the amount of the deflection. In the second column the maximum span is given where the deflection is not to exceed 1-360 of the span, which is about as great as can be used without cracking the plastering.

The first columns were calculated by the formula

$$\frac{W\,l}{8} = \frac{S\,b\,d^2}{6}$$

and the second columns by the formula

$$S = \frac{5}{384}\,\frac{W\,l^3}{E\,I}$$

in which

$W = \frac{w\,l}{12}$, or load per square foot times length in feet;

l = length in inches;

S = safe fiber stress, using a factor of of safety of 10;

b = width of plank = 12 inches;

d = thickness in inches;

s = deflection = 1-360 of l;

E = coefficient of elasticity, using a factor of safety of 2;

I = moment of inertia $= \frac{b\,d^3}{12}$.

The first table takes S at 1,200 pounds and E at 850,000, which is suitable for Southern or long-leaf yellow pine. In the second table S = 1,000 pounds, E = 550,000 for white oak. In the third, S = 800, E = 600,000 for Canadian spruce. In the last table S = 600 pounds and E = 450,000, which is all that is advisable to use for hemlock.

H. A. H.

Grinding High-Speed Steel Tools—The Sellers Tool Grinder.

Editor American Machinist:

At page 57, in a letter from Maurice E. Unwin, of Sheffield, England, upon grinding the new high-speed tools, I note as follows: "One feature of the new high-speed tools is that when ground on an ordinary emery wheel, even under a flood of lubricant, the surface of the steel becomes covered with fine hair cracks"; also, "Large tools are inconvenient to handle" in shaping tool grinders, among which he mentions the Sellers.

If Mr. Unwin has had a personal experience with the Sellers tool grinder, he must have used wheels different from those furnished or recommended by Wm. Sellers & Co., as all the new process air-hardening steels and high-speed tool steels are shaped and sharpened upon the Sellers tool grinder without "these fine hair cracks," which are caused by a surface contact of the wheel and steel, which excludes the water and overheats the steel, and the drawing away of the tool lets this heated steel become wet while hot. But the Sellers tool grinder permits a line contact only, under all circumstances, and this line contact is flooded with water, and the tool never overheats. This is peculiar to the Sellers

Uniform Load in Pounds per Square Foot	1 Inch Plank		2 In. Plank		3 In. Plank	
	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span
40	61	33	123	67	185	101
50	55	31	110	62	166	94
60	50	29	101	58	151	88
70	46	27	93	55	140	83
80	43	26	87	53	131	79
100	38	25	78	49	117	74
120	35	23	71	46	107	70
140	33	22	66	44	99	66
150	32	21	64	43	96	65
160	30	21	61	42	92	63
180	29	20	58	40	87	61
200	28	19	54	39	83	59
225	—	—	52	37	78	56
250	—	—	49	36	74	54
275	—	—	47	35	70	51
300	—	—	45	34	67	53
350	—	—	41	32	62	49

TABLE 3. SPAN IN INCHES FOR CANADIAN SPRUCE FLOORS.

Uniform Load in Pounds per Square Foot	1 Inch Plank		2 In. Plank		3 In. Plank	
	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span	Maximum Span For Strength Only	Maximum Span, Deflection not to exceed 1/360 of Span
40	53	30	107	61	161	91
50	48	28	96	56	144	85
60	43	26	87	53	131	80
70	40	25	81	51	122	76
80	37	24	75	48	113	73
100	35	22	67	45	103	67
120	31	21	61	42	92	63
140	28	20	57	40	86	60
150	27	19	55	39	83	59
160	26	19	53	38	80	57
180	25	18	50	37	75	55
200	24	17	48	35	72	53
225	—	—	45	34	67	51
250	—	—	42	33	64	49
275	—	—	40	32	61	48
300	—	—	38	31	58	46
350	—	—	36	29	54	44

TABLE 4. SPAN IN INCHES FOR HEMLOCK FLOORS.

tool grinder and can be confirmed by reference to fifty or more large engineering works in the United States who are using them.

In reference to handling large tools, the special No. 1 size of Sellers tool grinder handles tools with shanks 3x3 inches, or less. Of course any larger tools will not enter the chuck or toolholder, and if a smaller size of grinder is used, no larger tool can be ground upon it than will enter the chuck; but if the tool has a shank that will enter the chuck, the grinding will be done more rapidly upon the Sellers grinder than by hand, as the chuck presents the dull spot only to the wet emery wheel, and it is needless to say the tool is ground much more accurately, as hand grinding seldom, if ever, shapes two tools accurately alike.

J. WENDELL COLE.

Taper Holes in Machine Spindles.

Editor American Machinist:

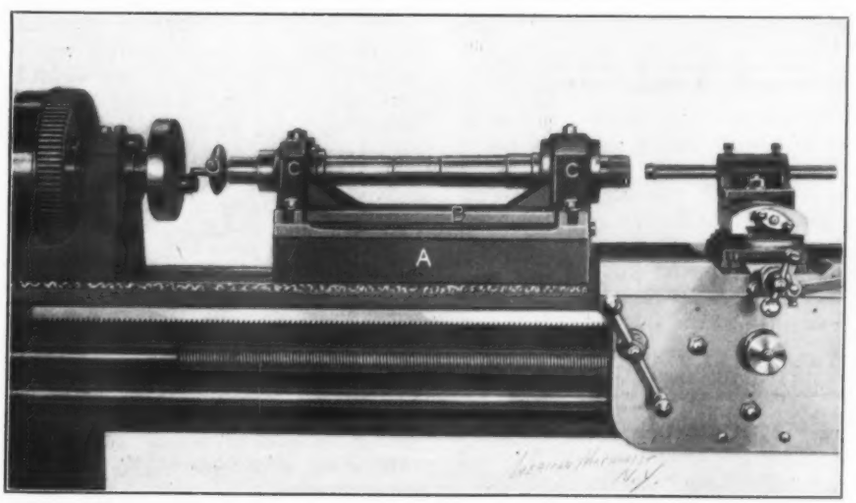
The accompanying photograph shows a fixture for boring taper holes in lathe spindles, consisting of a base *A* bolted to the lathe shears, and a head *B* pivoted at the end nearest the headstock, allowing it to swivel on the base to suit the taper. The two uprights *C* on the head are fitted with bronze boxes to accommodate the spindle, making a rigid support and one that enables you to do a good, true job without the use of a taper attachment or reamer.

J. R. P.

Filing and Indexing Catalogs.

Editor American Machinist:

I have seen several articles in your paper on filing and indexing catalogs, and will give a description of a method invented by Mr. J. D. Fry, of Grand Rapids, Mich., which I consider the best method I have seen.



BORING A TAPER HOLE IN A LATHE SPINDLE.

The essentials are elastic bookcases, cardboard boxes (enclosed on five sides) and a card index. The boxes are made about 10x12 inches and from ¼ to 1½ inches thick, as shown in Fig. 1. These can be had from any paper-box factory at an average cost of about 1½ cents each. The boxes are used as envelopes for the catalogs, and, being of uniform size, present, when put in the bookcase, an even and uniform front and make each catalog readily accessible.

In indexing, the catalogs are sorted alphabetically by firms' names and the boxes are marked in sections. For example, all catalogs from firms whose names begin with A would be in the A section, of which the boxes are marked with an A followed by a number, as shown in Fig. 2. By indexing in sections the file is always open for expansion without breaking its routine.

If an elaborate index of the contents of the catalogs is not desired, a card index of two sections, one for the firm names and the other for the subjects, will be found very satisfactory.

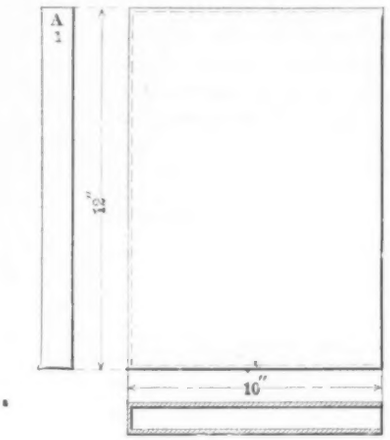


FIG. 1

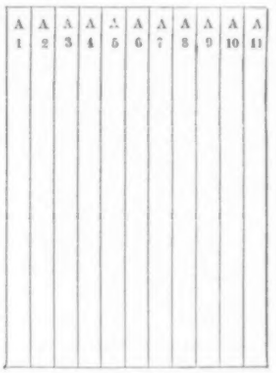


FIG. 2

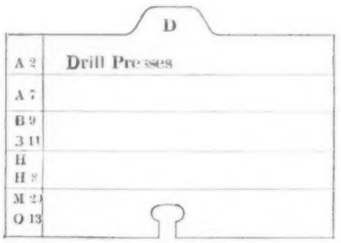


FIG. 3

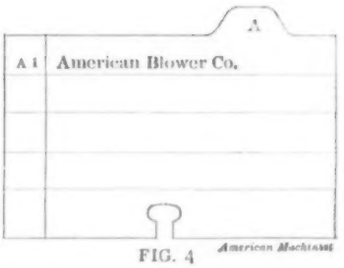


FIG. 4

FILING AND INDEXING CATALOGS.

If the name of a firm issuing a catalog is known, the catalog can be located at once from the firm name index, and if the catalogs relating to a given subject are wanted, their location will all be found on the card relating to that subject.

Figs. 3 and 4 show the methods of marking the cards.

Another very useful feature of this system is for the keeping track of loaned catalogs. When a catalog is loaned a slip of paper bearing the name of the party to whom it was loaned is placed in the box for that catalog.

Bound volumes which are too bulky for the envelopes may have a section of their own and their own index. It is, however, the small catalogs and bulletins which are most troublesome, and the cardboard boxes suit their case admirably. A great many firms have several small catalogs, one for each class of tools or appliances manufactured by them. With this system all may be kept together and added to as new ones come in.

For letters and numbers for marking the cases, procure 5-16 pasters, dead black, from any first-class bookstore. They are cut out and gummed and make a very neat legible job.

F. C. MASON.

An Employees' Record.

Editor American Machinist:

In all large manufacturing establishments it is important to keep a comprehensive record of employees. This record should be as brief as possible, so as to not cause unnecessary work, yet it must be complete enough to serve the purpose intended to the best advantage. Many methods are in use, but the card index system is more complete and less voluminous than any other.

Those of your readers who have anything to do with the employment of help in the shop are familiar with the trouble which arises from hiring incompetent men. The class of men that are available to fill positions in the shops are often not of the best, and it is a matter of importance, when a man applies for a position, to know if he has worked for the company before, and if so what his previous record was. A man may be employed, set at work and prove to be thoroughly incompetent, and if no record of the fact is kept he may come along several months later, apply for a position and be engaged again. This of course should be avoided as much as possible, as it causes annoyance and loss of money. Of course there are other points connected with such a record wherein a good system will be found valuable, such as noting increased wages, etc.

The first thing necessary is a suitable card, and such an one is shown in Figs. 1 and 2, of which the former is the face and the latter the rear side. This card should be filled out and filed in alphabetical guides, and if the record is kept by the time department or in the office of the superintendent, it will be found best to have a separate index for each separate department of the shop—that is, for the machine shop, blacksmith shop, erecting shop, boiler shop, foundry, etc., as it will thus be easier to locate any particular man in a certain department than if the men are all indexed under one index. Some would probably prefer to have a record of this nature kept by the foreman of each department, because the foremen do the hiring of the men, and if this is desired it could be provided for in the same manner.

Understanding the requirements for such a record, it is sometimes desirable for the superintendent, foreman or time department to pick out one particular kind of help in one department, and without some special or cross-index this could not be readily done. The method shown in Fig. 3 will, however, do this very nicely. If in the machine shop we have vise, lathe, planer, shaper, milling machine, boring mill, floor and machine men not otherwise specified, the cards would be filed alphabetically, as already described, but in addition to this, in front of the alphabetical index a specially ruled card would be placed as shown in Fig. 3. Then by the use of steel pointers which project above the cards in line with the section rulings, as also shown in Fig. 3, all men of a given class can be located. This is the only system whereby cards may be indexed in two ways with a single file. The steel pointers can be purchased from the Vetter Desk Works, Rochester, N. Y. They are inexpensive, and will save much time in making and consulting a record of this kind.

Such a system will be found valuable not only for keeping the record of employees, but also for use by the time department in making out the pay-roll and for ready reference for the rate of wages for the different men, etc.

H. G. HAMMACK.

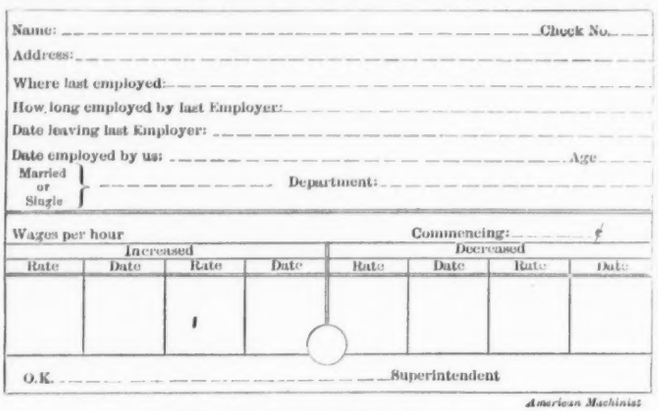


FIG. 1. EMPLOYEE'S RECORD CARD.

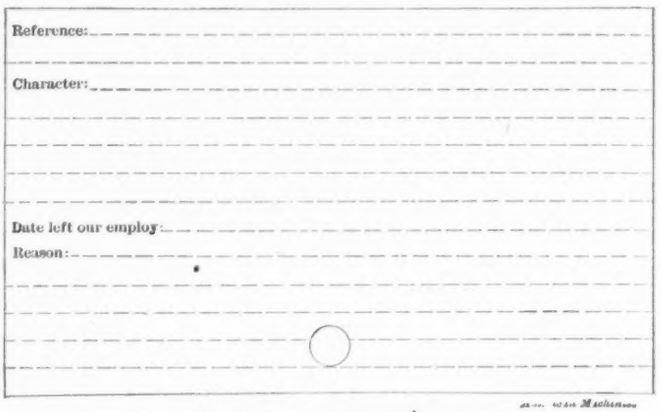


FIG. 2. REAR SIDE OF EMPLOYEE'S RECORD CARD.

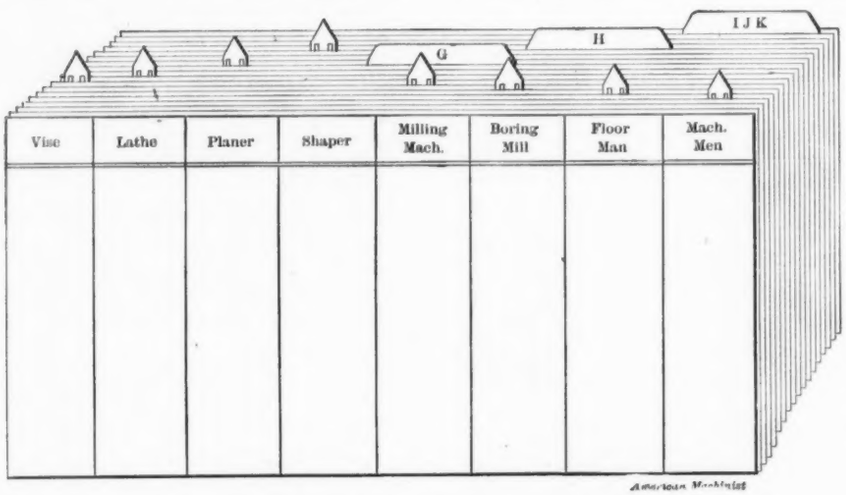


FIG. 3. THE USE OF STEEL POINTERS FOR DOUBLE INDEXING.

Hardening and Correcting the Lead of Taps.

Editor American Machinist:

At page 57 the writer takes exception to statements in an article of mine at page 1771, Vol. 26.

According to my experience, very little is ever gained by two parties going into an argument over some question regarding which each entertains a view which he considers correct and is bound to uphold because publicly on record as entertaining such view. No one realizes more fully than myself the folly of attempting to sustain an assertion by a statement that we have had so many—be it five or fifty—years' experience in a certain line of business; yet a certain number of years of practical, successful experience cannot fail to give a man confidence in methods he has experimented with and found satisfactory.

My attention was first directed to the subject of pack-hardening taps by the trouble we were experiencing with taps we were using to tap pieces made from a high carbon open-hearth steel which we bought forged to shape and annealed. As we were badly driven in our toolroom, we bought most of our taps, and naturally laid the trouble we were experiencing to the boughten article. As a consequence, we decided to make this particular tap; the results, however, were not as desired, for while the home-made article worked as

well as the taps we had bought, it did not stand any better and cost us more.

We were at this time, and had been for some time, pack-hardening most of our milling machine cutters and dies for punch press work, with admirable results, and the suggestion was made that we try this method for the taps. I freely acknowledge I was skeptical as to the results, for while we were able to run our milling machine cutters much faster, and they would stand up much longer when treated this way, I had my doubts as to its being practicable when applied to taps.

One trial, however, proved to our satisfaction that the taps would stand up much better, hold size longer, and the percentage of breakages was not half of what it had been. Our success led us to try the method for hardening taps that were to tap malleable iron, also for those to be used on tool steel, and the results were as gratifying as those obtained by our first trial.

This experience was not derived in a shop using a tap only occasionally, because when we finally made what taps we used in the factory, it required the services of three, and part of the time four, men to make what taps were needed, and these men were not required to cut the grooves in the taps either, as that was done by the regular milling machine men. I have had occasion to harden taps and similar tools for parties who had heard of the success we were having, and invariably they have been pleased with the results.

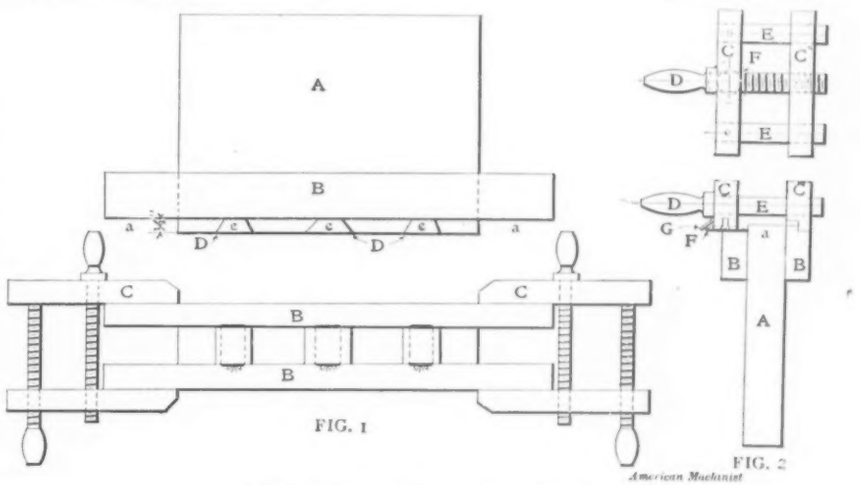
I think it should be the ambition of every man who has made a success along lines of general interest to mechanics to give the results of his experience to his fellowman, and in return he is able to get many valuable points from the experience of others. Now, I have at times been extremely annoyed by the change in lead, especially when *long* holes were to be tapped and fitted with screws whose threads were chased with a tool governed by a lead screw, and experience had shown me that taps could be hardened by this method which did not become altered as to lead so that it was apparent when tested by any means possessed by the ordinary shop.

My article was written with a view of possibly helping someone experiencing the same difficulties I have had, not with the intention of telling the manufacturer of taps how he should do his work, as might be inferred from the remarks of "Quirk."

The amount of shrinkage mentioned—.01 inch in 1 inch of length—I have seen often enough to warrant the statement that it is not uncommon; possibly I should have been more specific in my statement and not appear to try to convey the idea that, as a rule, taps contract the amount mentioned. My attention has been chiefly given to taps that gave trouble, and as I have had occasion quite a number of times to go to shops where they were experiencing trouble, I have had my attention directed to this error more frequently, probably, than men in general.

Because a piece of steel contracts on its surface a certain amount in 1 inch of length it does not necessarily follow that a bar 1 foot long will contract twelve times that amount. Pieces whose surface is a succession of ridges, or of threads, as a tap, will contract more than the piece of steel itself when measured over all, measuring at the center. A milling machine cutter tooth, for instance, will contract more on its cutting face than it will directly back of the edge, where the resistance to shrinkage is greater; so the lead of a tap may alter more through shrinkage than the piece of steel towards the center, where the resistance is greater.

I have frequently noticed the tendency of a milling machine cutter tooth to contract as mentioned, and know that reamer teeth, as well as similar surfaces on steel pieces, when heated red hot and suddenly cooled, contract more than the portion directly back of them.



BINDING THE AMERICAN MACHINIST.

I have had charge of plants where hundreds of dollars' worth of work was hardened daily, and have hardened thousands of taps, ranging in size from very small to very large, and from those used in a hand-tapping machine to staybolt taps, and I must say I consider pack-hardening by far the most satisfactory method I have ever used for taps intended for any kind of work. The more difficult the stock is to tap the better this method shows up when rightly practiced.

E. R. MARKHAM.

Binding the American Machinist.

Editor American Machinist:

Perhaps some of your readers will be interested in a cheap but serviceable binding for the AMERICAN MACHINIST. After removing the advertisements and arranging in proper order, clamp securely as shown in Fig. 1, where *A* represents the papers to be bound, *B B* two strips of wood about 1x2x18 inches, *C C* common clamps or hand-screws used by all wood workers. The edge *a a* should be true and care should be taken to have this edge parallel with the paper. Set the clamps up tight and saw three places at *D D D*, using a fine handsaw. Tie the three portions *e e e* fairly tight, using a fine strong cord. A piece of silk fish line is just the thing to use. Now give the back a coating of thin glue and put a little on each knot to keep them from untying. After drying the clamps can be removed and the cover put on. For a flexible cover use heavy brown paper, cloth or leather. Cut two pieces a little larger than the paper, then cut a piece of black cambric or any strong cloth as long as the paper and wide enough to cover the back and to lap half an inch on each cover. Paste the covers on first, then glue the cloth over the back and on to the edges of both covers. Paste the first page of the AMERICAN MACHINIST outside the front cover, and the job is done. Board covers can be used if preferred; the operation is just the same. Six months of the weekly issue make a volume 1⅝ inches thick, which is all right.

If care has been taken in arranging the pages, no trimming will be necessary; but if a neater looking book is desired any bookbinder will true the edges for a small amount. I have made a neat tool for trimming the edges after the binding as above described; this is shown in Fig. 2. *A* represents the volume with the edge *a* to be trimmed. *B B* are strips of wood about 1x2x18 inches. Clamp the paper as tight as possible between these strips. *C C'* are strips of hardwood 1x2x6 inches, *C'* is tapped for the hand-screw *D*. *E E* are round hardwood rods pinned into *C* and a sliding fit in *C'*; these serve as guides.

D is a hardwood screw taken from a common hand clamp. *F* is the cutter, ⅛ inch thick and 1¾ inches diameter. This is let in flush with the bottom of *C* and fastened with a good-sized wood screw. As soon as the edge is dulled, the screw can be loosened and the cutter turned a little, thus bringing a new sharp edge into place. The cutter must not turn while using the device. *G* is a guard for the hand. Now, to trim the edges it is only necessary to pass the cutter back and

forth, turning the hand-screw a fraction of a turn at each stroke. Keep the cutter sharp, and anyone can do as fine a job as any bookbinder. All the wood detail of this device can be made from a pattern-maker's hand clamp; any machinist can make the cutter, and one in a shop is enough for all hands if the maker will loan it. S.

The Advertisement Writing Mechanic.

Editor American Machinist:

Your communication signed "Art. Isan" (page 165) is interesting as an example of a suggestion to fly without telling us how.

Like most mechanics (and I'm a mechanic myself), Art. thinks some of the boys in the shop ought to be promoted. Granted.

But the boys in the shop must do something to attract attention before the boss, or anyone else, can find them.

Salesmen are born, not made.

Some of them learn trades before they "find themselves"; some of them clerk, thump typewriters or black boots.

The commercial instinct will develop with very little cultivation if it's there.

The mechanic would be a better machinery salesman than a bookkeeper would be if he had as much of the commercial instinct. Otherwise he would not.

But I started in to say a word about mechanical ad. writing.

The ad. writer, say on the AMERICAN MACHINIST, *ought* to know something of mechanics—but he *must* know something of advertisement writing. That is what he is hired for.

He must have enough of the commercial instinct to see the "talking points" in a machine and exploit them. He must be able to write good, plain English.

The best mechanics will talk to you by the hour of the beauties and ingeniousness of some detail of their machinery—but, bless you, they never think of using it in their advertising.

We have been out with a dark lantern and a jimmy for the past six years trying to find a mechanic who could write a decent advertisement.

We want to pay him more money than he can get in the shop, for shorter hours.

We have advertised for him, and are advertising for him now. We get replies and applications from alleged ad. writers—such as they are—but never a nibble from a mechanic.

We have watched the home-made ads. for one that stuck out beyond the rest, and then tried to hire the man who wrote it, but in every case found he had an interest in the firm.

There's another thing that perhaps Art. has not thought of.

Many men who own and manage machinery-making plants are not mechanics; few purchasing agents are. They do not know some of the plain, everyday facts about machines—they are "from Missouri and must be shown."

There is often a good reason for writing ads. so that a child will understand.

Read any machine maker's catalog—it details the simplest things so that they are plain to the primary class.

The AMERICAN MACHINIST office needs another ad. writer, who is a mechanic and can get up a decent ad. for machine tools; and if Art. or any of his friends know of such a one that needs a job, tell him to come right up to the office and ask for

THE OLD MAN.

System for Checking up Inquiries Caused From Advertising.

Editor American Machinist:

I have been much interested in reading the article on checking advertising inquiries at page 114, especially as I have spent considerable time during the last five or six years in trying different plans along this line.

It seems to me that it is better, in making a record of the inquiries and their source, to have a separate place in which to record the inquiries for each medium. For instance, I have used a small blank book with pages about the size of an ordinary sheet of letter paper, devoting certain pages to each medium. By means of an index, these pages may easily be located. At the top of the first page of each section I place the name of the the medium, the amount of space used, the rate paid for it, the time and expiration of the contract, the key used in the advertisement, and have also found it convenient to paste on the page a copy of the advertisement used. This, however, is better kept in a separate book.

When an inquiry is received and the source is discovered, the date, the name and address, with any desired information as to kind of machine inquired for, are noted under the proper headings.

The weak point about Mr. Willand's system, at least to my mind, is that he fails apparently to make any distinction between *inquiries* and *sales*. After an inquiry is registered is no time to stop using the advertising record. It has been my experience that some papers bring lots of inquiries and few or no sales. Other papers with fewer inquiries bring as many or more sales. When a sale is made to any inquirer whose inquiry was traced to an advertisement, that name in the record should be underscored in red ink, or designated in some such prominent way, together with a record of the size and type of machine sold. It is remarkable the difference in red marks that there will be during the year between trade papers and other mediums having about the same number of inquiries to their credit.

One of the best trade paper recommendations I have ever seen read as follows: "More than 75 per cent. of the inquiries *that bring business* come through your paper." However, this is not a safe guide in itself, for the kind of medium must be considered. In other words, some mediums bring *direct* returns, others *indirect*. A paper circulating, for instance, mainly among machinists employed at the bench will not likely bring *direct* returns for large machine tools. But these men at the bench sometimes exert a powerful influence when machine tools are to be purchased, and that medium may, and very likely will be, a valuable one because of the indirect sales.

Again, the size and style of machines sold make some difference. For instance, a factory had been for years engaged in the manufacture of machine tools of a certain kind. Later a line of engines was taken up, and after several years this became the main line, while the machine tools were secondary, and were being built only in sufficient numbers to keep the shop going until such a time as the engine business would require the entire capacity of the plant. Advertising was carried on both lines, alternating the advertisements. By means of the above system (as would also be the case in Mr. Willand's) it was determined what mediums brought the most inquiries and sales for the engines and what for the machine tools, which was the less desirable business in view of the change in the line of manufacture.

Of course, the work of crediting sales means that much extra clerical work, but can easily be taken care of by means of an index of names of inquirers, if the total number of inquiries is very great. At any rate, it is well worth the expense incurred.

The system of collecting together all inquiries from one source also enables one to judge whether a medium maintains the same value throughout the year. It may also be used in determining the relative value of using space in a weekly every issue, or in only one or two issues per month. This system showed very plainly in one case that an advertisement in only half the issues of any paper, whether monthly or weekly, brought only half the returns secured by using every issue.

The real object of this letter is to point out that in considering the returns from advertising we must consider *sales* as well as *inquiries*. Not only this, but the expense of space used must be considered. For instance, I heard one advertiser say some months ago that one paper brought him much better returns than another devoted to the same industry.

"How much space do you use in the better one?" I asked.

"A quarter page."

"How much in the other?"

"One inch, single column."

"Yes," said I, "you invest $5 in one paper and expect the same returns that you get from $50 in another paper."

Now, as a matter of fact, that one-inch advertisement *may* have been paying larger dividends than the quarter-page advertisement. A man doesn't expect the same

quantity of interest on a $5 deposit in a savings bank that he gets on a $50 deposit in another savings bank.

Cost, quantity and character of sales, character of the readers and whether indirect returns are to be expected rather than direct returns, etc.; all these things, not merely the *number* of inquiries, should be considered, and the system outlined above will give such information at a comparatively low expense and in a very desirable form.

As to the card Mr. Willand sends out with his reply to inquiries, I should be glad to know what proportion are returned. I too have used such a card, and while I considered it well worth the small expense, about one-third were never returned. ALBERT STRITMATTER.

Machine Tools and High-Speed Steels.

Editor American Machinist:

We hear a great deal about redesigning our machine tools to keep up with the new high-speed steels, which may be all right for some styles of machines, but for others does it not call for new practice in addition to new design?

Take the lathe, for instance: how unsatisfactory it is to try to make it cover a large range of diameters. We are hindered in a belt-driven machine by the limit of belt speed, followed by the limit of gear speed, and so on. Again, if we discard great ratios of back gears, we get enormously wide belts. The only conclusion is to design our lathes to cover a small range of diameter and estimate the least horse-power we can get along with for the largest diameter to be turned, and let the power climb up for small diameters. I remember very well an article advocating

Diam. of Work.	Cutting Speed, feet.	Spindle R. P. M.	Back Gear ratio.	Pulley R. P. M.	Belt Speed in feet.	H. P. 5 inch Double Belt
1½"	12	31	36	1,116	4,000	30
	36	93	12			
2"	16	31	36	1,116	4,000	30
	48	93	12			
2½"	20	31	36	1,116	4,000	30
	60	93	12			
3"	20	25½	36	920	3,300	26
	60	76	12			
3½"	20	22	36	792	2,900	21
	60	66	12			
4"	20	19	36	684	2,500	18
	60	57	12			
4½"	20	17	36	612	2,250	16
	60	51	12			

Variable speed countershaft, ratio 3 to 1. Back gear ratio, 12 to 1. Extra back gear ratio, 3 to 1. Total ratio, pulley to spindle, 36 to 1.

TABLE 1.—LATHE DRIVE FOR DIAMETERS FROM 1½ TO 4½ INCHES.

this written by John J. Grant in 1895, and have always beleieved that for manufacturing purposes these special lathes are all right. Of course the jobbing shop will always call for a lathe of large range, and it will, I suppose, continue to be sold.

I have made some tables of drives for lathes showing approximately what the machine-tool designer has to contend with along this line. Table 1 shows a drive for a lathe to turn from 1½ up to 4½ inches diameter; belt limit, 4,000 feet. Table 2 is for a range from 2 to 6 inches diameter; belt limit as before. These are laid out for a variable-speed countershaft drive, and it will be noticed that for each diameter only two speeds are given, as the

Diam. of Work.	Cutting Speed, feet.	Spindle R. P. M.	Back Gear ratio.	Pulley R. P. M.	Belt Speed in feet.	H. P. 6 inch Double Belt.
2"	13½	25½	42	1,070	4,000	43
	40	76	14			
3"	20	25½	42	1,070	4,000	43
	60	76	14			
4"	20	19	42	800	3,150	32
	60	57	14			
5"	20	15¼	42	640	2,500	26
	60	46	14			
6"	20	13	42	548	2,100	21¾
	60	39	14			

Variable speed countershaft ratio, 3 to 1. Back gear ratio, 14 to 1." Extra back gear, 3 to 1. Total ratio, pulley to spindle, 42 to 1.

TABLE 2.—LATHE DRIVE FOR DIAMETERS FROM 2 TO 6 INCHES.

variable speed countershaft will of course cover all speeds between.

Table 3 gives a drive for diameters from 4 to 46 inches, and here is where the trouble is obvious. Note that for turning 46 inches diameter at 15 feet only 6 horsepower is obtainable, whereas in a lathe with less range it would have been a great deal more.

At this point I would like to use this Table 3 to demonstrate why it is that a milling machine is such an efficient machine tool. We will presume that an 11-inch cutter is a fairly large cutter, but with the drive of Table 3 such a cutter would have 18 to 25 horse-power, as against 6 horse-power for 46 inches diameter of lathe work.

Compare a slab milling machine with a 6-inch diameter cutter having a driving gear 24 inches diameter with a lathe with a 24-inch diameter driver on work of 24 inches diameter. Assume a tooth load of 10,000 pounds, and the lathe gets 10,000 pounds cutting load, while the milling machine gets four times as much, or 40,000 pounds. This may appear to some a little elementary, but it is a true condition and cannot be ignored.

At page 1788, Vol. 26, Professor Sweet speaks of drives, recommending the worm gear, and goes on to compare a screw and nut with the Sellers drive and calls the screw and nut theoretically perfect, but says the nut wears out. Did he not overlook the lead or angle of the thread, and is he not making an unjust comparison?

The ordinary single-thread worm is not efficient, but will not a screw with an angle of, say, 30 degrees, last as long as a Sellers drive? For my part, it seems that if the diameter, material, etc., were the same the life would be largely in favor of the screw and nut.

The professor also takes exception to a hobbed wheel, and says experience shows a worm twisted around to mesh with spur gear will run easier and last longer. It would be interesting to see some tests by Professor Sweet, and to compare them with others made to show the efficiency of the Hindley worm compared with the common worm. E. J. LEES.

Prices of Materials for Draftsmen.

Editor American Machinist:

The modern tendency to specialize is at fault in that it is likely to limit the individual capacity of young engineers. Nowadays a man cannot hope to be a Jack-of-all-trades and succeed, but the more notes he keeps of work done by others the more confidence will he feel when entering a position requiring more than limited knowledge. Workers in special lines too often ignore others upon whom their work depends. In a works where each department aims at perfection in its own special line it may be frequently noticed that there is not enough give and take among the departments. This state of affairs is to be noticed between the general and drawing offices as much as anywhere, and is to be accounted for by the fact that the clerk is not an engineer and the draftsman is not a business man. In an up-to-date drawing office perhaps 90 per cent. of the men have had no business experience, consequently they will display appalling ignorance as to the design of a machine to be sold at a profit. This is where a purchasing clerk can save money for his firm.

Apart from the costs of manufacture, the draftsman should be kept posted in the current prices of materials, when he

Diam. of Work.	Cutting Speed, feet.	Spindle R. P. M.	Back Gear Ratio.	Pulley R. P. M.	Belt Speed in Feet.	H. P. 7 inch Double Belt.
4"	15	14¼	14 to 1	200	950	12
	60	57	14	800	3,800	45
11"	15	5¼	84	440	2,100	25
	60	21	14	294	1,400	18
18"	15	3½	84	294	1,400	18
	60	12¾	14	178	850	11
25"	15	2¼	84	189	900	11½
	60	9¼		775	3,650	44
32"	15	1¾	84	147	700	10
	60	7¼		610	2,900	37
39"	15	1½	84	126	600	7½
	60	6		504	2,400	30
46"	15	1¼	84	105	490	6
	60	5		420	2,000	25

Variable speed countershaft ratio 8 to 1. Back gear ratio, 14 to 1. Extra back gear, 6 to 1. Total ratio, pulley to spindle, 84 to 1.

TABLE 3.—LATHE DRIVE FOR DIAMETERS FROM 4 TO 46 INCHES.

may be more certainly expected to design a piece of goods which will cost under a certain sum to manufacture. If a draftsman cannot obtain these prices by private request, official assistance should be asked for. Such current prices may be conveniently arranged in tabular form and blueprinted. Such a table is intended to

be used only as a guide for designers, though it has proved of assistance for "guess estimating." It may be made as elaborate as required, and would naturally vary with varying classes of work. It must, of course, be kept up to date, and all such tables should be of uniform size, so that they may be neatly fastened together.

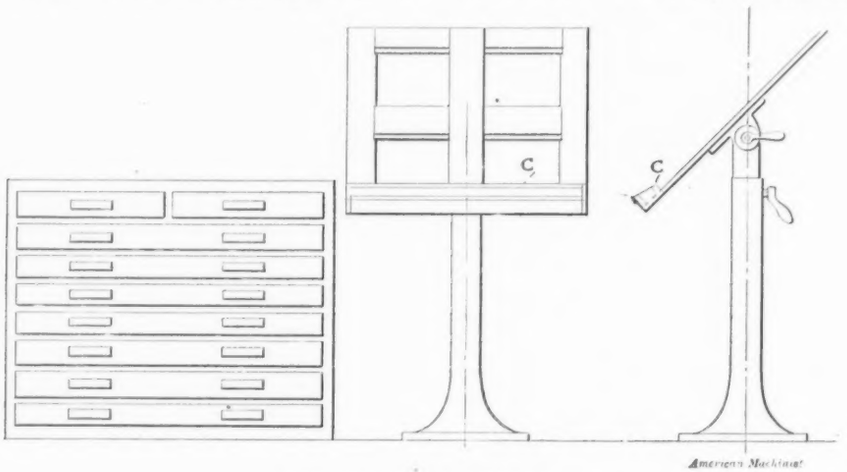
This may prove useful to some of your readers, being one manner in which one department in a works may work with another. R. D. S.

Birmingham, England.

Drawing Tables.

Editor American Machinist:

Mr. Randol in describing Mr. Platt's drawing tables at page 1353, Vol. 26, said that in his opinion a flat table was the handiest. That, I think, is largely a matter of use, but the great thing in favor of a board which is vertical, or nearly so, is the more favorable position in which one works when using it, compared with a flat board. However, a steeply inclined



DRAWING OFFICE EQUIPMENT.

board is not easy to figure on, so if a vertical board is used it should be easily adjusted in inclination. The sketches show an adjustable drawing table which is both cheap and efficient. The cabinet on the left-hand side is used to store shop drawings, the top drawers, however, being reserved for the draftsman. The top is used as a rest for loose drawings that are being referred to. This arrangement, when the drawings are stored in the office, is very compact. The drawing board rests on ledge *C*, the one underneath being used to hold drawing instruments.

Manchester, Eng. H. T. Millar.

That Mixture for Preventing the Freezing of Shop Windows.

Editor American Machinist:

I have tested the mixture mentioned at page 1791, Vol. 26, for keeping windows from freezing. I used the same ingredients, but made only one-fourth the quantity. I made it as follows: ½ pint of 62 per-cent. alcohol, ½ ounce of glycerine, with just enough oil of amber to change the odor of alcohol. I rubbed it on the inner surface of the glass, but it had no effect, as it was frozen in half an hour after it was put on.

I then added one-fourth more glycerine as stated, and this made it a little better; that is, it did not freeze so soon, but it was no success. I then added one-half more glycerine, and found it no better; next I tried glycerine alone, but this proved a failure also. A. Mertes.

"Christening a Gas Furnace."

Editor American Machinist:

A few months ago a large gas blast furnace was brought into the toolroom, and the word was passed around that one man was to do all the hardening when the new furnace was installed; consequently we were all interested enough to watch the proceedings.

The demonstrator came in about 9 o'clock, and the blacksmith and his helper were there to be initiated into the workings of the new furnace.

All the burners were tried, and after adjusting the valves to get the proper mixture of air blast and gas, a large blanking die was put in to be heated. This seemed to heat rather slowly, so the other two burners were lighted, and some small pieces were heated in the forge blast. The lead bath or pot burner was burning, too, so that altogether there was a great deal of heat above the furnace. The blanking die was getting along nicely and would soon be ready to harden. During this time the toolroom air had become blue with smoke and gas, and it was certainly becoming fierce; the roar of the blast could be heard over the whole room. The blacksmith had a disgusted look on his face as he stood and looked on, and I believe everybody else in the room sympathized with him. To bring the thing to a climax, the unexpected happened—the heat of the furnace melted the solder on the fire-extinguishing system valve under which the furnace had unknowingly been set; and as the water rained down on the hot body of the furnace, just imagine the effect. Then the belt on the air-blast pump came off and the gas flame shot clear up to the countershaft hangers. All this happened in less time than it takes to tell it, and when the demonstrator recovered from the shock he dashed through the rain and shut off the gas. With the pressure turned off the water soon stopped coming down, and sawdust was spread around the floor to soak up the water.

The superintendent, who had been in and out watching things, came in at this time and, with a look at the floor and ceiling and a few words to the foreman, he left the scene. The blacksmith gathered up his tools and departed whistling "He never cares to wander from his own fireside." That was all the testing the furnace got, for in a short time it was crated and returned. H. I. Green.

Cleveland, Ohio.

Indexing by Numbers Alone.

Editor American Machinist:

It is very encouraging to note how an idea grows. Mr. Ferris's article on "The Group Drawing Office System" at page 107 shows that the numerical leaven is working. Of course the old idea dies hard, and the new one is only given a grudging welcome, but, bit by bit, it grows. Mr. Ferris says: "Thus we got to using the list numbers as *names* and every foreman would soon know what was meant by 3.126A. Standard list numbers become familiar," etc.

When Mr. Ferris realizes that the A, B and C are wrong, and uses numbers only, and a different number for every different thing, he will find matters simplified very much indeed.

Steam shovels are not in my line, but I do not think it makes any difference whether we have to deal with steam shovels or sewing machines, as the same principle will apply. We build some machines to order one at a time, and we build others in numbers continuously. We make great numbers of combinations of various parts of machines, and yet the simple numerical index with no letters or symbols solves all the difficulties. Some of the machines we build have 400 different pieces in them, perhaps as many as a steam shovel, but while not so large the items take up just as much room on a "set of parts" list, which name we prefer to "bill of material" because, when a complete machine is analyzed, it becomes only so many different parts aggregated or assembled.

How simple it becomes to have a card index or order read: "No. 123 wrecking crane, composed of the following parts: 673 to 676, 732, 733, 734," etc., or "No. 129 wrecking crane, composed of the following: 492, 616, 620, 624, 732, 733," etc.; or a note can be made on the card thus: "This crane is exactly the same as No. 123, except that it has a 20-inch drum instead of an 18-inch drum; therefore omit 673 to 676 and substitute 492, 616, 620 and 624."

My experience has been that if changes

are trivial, such a memorandum will do, but in practice a distinct and separate set of parts list for each machine is best. If numbers only are used, the clerical work is trifling, and the liability to error and confusion is reduced. The person whose business it is to furnish the material or set of parts list must have such a list in some form, and why not plainly and clearly written out? As the material has to be charged up, such a list must eventually be made out, and why not do it at first?

There is too much of this complicated symbolic numbering. If the arbitrary number is given an opportunity it will be found to be the best. Why depend upon the placing of a dash, thus: 3126—1, or a dot, thus: 3.12, to express a meaning? Give the part a number, and the card index will do the rest.

One piece, one number. This number will find the pattern, the piece or the drawing. If the set of parts is taken into the drafting room, all the drawings can be found without any further investigation, and the patterns also. If there is no such number in the drafting room or pattern stockroom, then there is no such drawing or pattern to look for. The drafting room and pattern room indexes will have all the numbers, whether they have anything to represent them or not, and a cross opposite the number can be used to signify that there is nothing bearing that number. For instance, it became expedient recently to drop numbers 4300 to 5000, and all that was necessary to do was to put a card in the box saying, "Nos. 4300 to 5000 are not in use."

There is too much reverence for drawings. A drawing is, after all, only a pictorial order with written instructions, and is intended to take the place of verbal orders. Why not, therefore, say on the drawing what you would tell the workman? Helpful suggestions, as to best method of machining a piece, should be written on the drawing, and then there they are for the next time.

When a change is made in a pattern so that it can be used for a new purpose as well as the old, no change should be made in its number, but a note can be made on its index card of the various uses it has. Sometimes an addition, such as a lug or a boss, is made to attach to a pattern, by which it is adapted to a new purpose, but for the old purpose this piece has to be omitted. This situation is met by the simple expedient of giving the attachment (which should be detachable) the number of the changed part, thus: "No. 162, plaiter roller, bottom. Note—By addition of boss 247 this pattern will do for roller, top 247," and the card for pattern 247 will say: "This boss is to be attached to pattern 162 to make roller 247." Patterns 162 and 247 should be kept in separate places.

The scheme advocated by Mr. Ferris has the defect that it calls for no less than six separate sets of numbers for the same thing. For instance, in his Fig. 3, why should not the drawing number 6912 do for the list and order numbers, and why shouldn't the group drawing number, the group number and the number of sections be omitted? They are unnecessary.

If a wheel 6247 is used on a conveyor, a locomotive, a crane, a steam shovel and a coal hoisting machine, what is required except to know it as 6247? That should convey all necessary information, and an assembled drawing of a machine, or part of a machine, should have each part numbered with its separate number, which will give at a glance, its drawing number, pattern number, etc.

It stands to reason that if a piece is a stamped steel bucket, a spring or a steel shaft, one will not look for pattern numbers, and if the piece be a casting, its drawing will so state.

A recent example of the application of the numerical system by us is the building, to order, of 150 machines, of four kinds, each of which contained about seventy-five different parts, and more than one-half of these parts were alike in all the machines. Many were stock parts, some were entirely special, some were made from stock parts with slight changes or additions. Some of the special parts were also alike, with slight changes. The first step was to number each kind of machine. The second was to *begin* a list of sets of parts, noting at once the stock parts and those in which slight changes were needed, to each of which a new number was given. Thus some parts were under way—and in fact some were finished—long before the complete drawings were made. Carrying out the unit idea, each separate part of the machine is treated separately; and as the entire machine cannot be assembled until all, even the smallest, parts are ready, we began on them as soon as possible. As fast as each separate piece was decided on, it was numbered, such parts as had to wait until the entire assembled drawings was done coming last, of course.

The old drafting-room tradition, of a large sheet, or several large sheets, containing all the parts of a machine, dies hard, and even when considered good and dead, in some places it bobs up again, in some group form or otherwise.

The first step is concentration; then comes specializing or separating. The drafting room should not be worried about the filling of orders. Their task is to give the orders and to show how to obtain the results. It is for someone else to see that the orders are carried out.

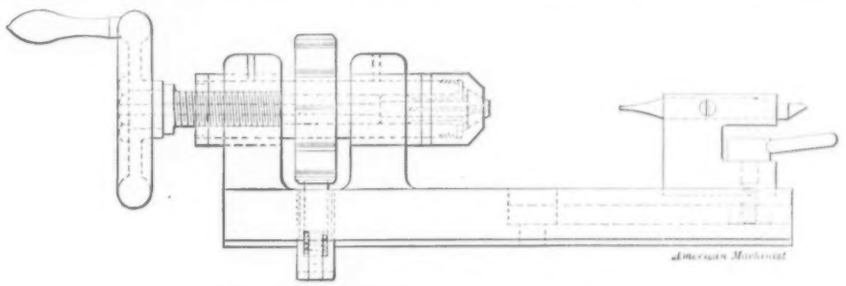
ROBERT J. HEARNE.

Fixture for Milling Taps, Reamers, Etc.

Editor American Machinist:

I have found a fixture made like the accompanying sketch to be very handy, quick and reliable. The working parts are all hardened, the spindle being ground and bearings lapped. The working of the chuck is easily understood. By turning the crank wheel the spring chuck is forced against the hood on the end of the spindle, clamping the tap to be milled. The index wheel, fastened to the spindle, has twelve 90-degree notches cut about ⅛ inch deep. With this we can cut 12, 6, 4, 3 or 2 teeth, and the spring shells will take as large as a 5-16 inch tap.

To index it is only necessary to turn the crank wheel as if to tighten the chuck, and the abrupt bevel on the index pin permits the turning of the index spindle; the click of the index pin when it strikes the notch in index plate is sufficient for counting when spacing. The tail center is reversible, one end having a female and the other a male center. A hole through the clamping screw allows the milling of long shank tools. H. T. G.



FIXTURE FOR MILLING TAPS, REAMERS, ETC.

As is well known, a good many men identified with various branches of engineering took part in the Spanish war, and it is proposed by certain Commands of the Spanish War Veterans' Association to hold some sporting events in the armory of the Twenty-Second Regiment, New York city, on March 5, 1904, for the benefit of widows and orphans. Particulars are to be obtained by addressing Gen. Eugene Griffin, 44 Broad street, New York.

There were 5,152 locomotives built in the United States in 1903, of which 88 were electric locomotives. The number produced in 1902 was 4,070, and the increase for last year is the greatest on record. As many might be required this year, if only the actual physical condition of the country and of the roads were to be considered. But there are Wall street and labor troubles and an approaching Presidential campaign.

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The Inventor of the Link Motion.

We publish in this issue an article regarding the origin of the link motion, which will be by some perhaps considered useless at this late day. We do not know that Williams is now living to receive in person the honor and the credit which we believe to be his just due. But next to doing justice at the beginning is to do it as soon as you can, and this we do by the publication of the article referred to, based upon the testimony of Ralph Little Whyte, who was at the time in a position to be thoroughly well acquainted with what took place, and who in a recent letter to the author of the article says:

"I have read with interest your article relating to the invention of the link motion, and approve of it and endorse all you have said regarding my connection therewith. You cannot emphasize too strongly that young Williams invented what is known as the Stephenson link motion, and that the credit for it was simply filched from this lad by Howe. Should you require my affidavit as to the truth of what I have said concerning my connection with this invention, to be held as authority for and in confirmation of what you have recorded, I shall be glad to supply you with such."

We believe there is not the least reason to doubt the accuracy of the story as Mr. Whyte tells it; so far as we can judge, he is not in the least influenced by prejudice for or against anyone connected with the events he describes. We believe it is true, as he declares it is, that Williams, who at the time was a mere lad, invented what has come to be known as the Stephenson link motion, and that he should be given the credit for it, the various authorities cited, to the contrary, notwithstanding.

We do not here go into the matter of James' invention of a link motion previously in New York. That is a story apart and it is generally agreed that the link invented by Williams and generally credited to Howe is the one that went into locomotive construction. It was, we believe, a clear invention, as much so as if James' link had never been thought of.

Adherence to Traditions.

The practice of machine shops, like the ideas of the men who operate them, runs in grooves more or less, and very frequently one encounters evidence that a certain problem will be attacked and solved, if solved at all, in a certain way in a certain shop, and in an entirely different way in another shop, depending not so much upon the specific conditions of the problem in hand as upon the general methods in use in the particular shop—in other words, in accordance with its traditions. For instance, in a printing press works things will be attempted by the use of spur and bevel gears which would not be thought of in that way in many other shops. Certain aspects of the printing press business drive home the conviction that every part of the machine absolutely must move in absolutely fixed relation to every other part, and it is easy to see how this fact might lead a man who for years has done nothing but design printing presses to do some curious things in the way of machine design.

An interesting instance of this was seen the other day on a printing press which had been built by a very prominent establishment for the purpose of doing a special job of printing in a manufacturing establishment. This rotary press turns out printed sheets of paper of small size in two colors at a very rapid rate, delivering them from a cylinder to which the sheets are held during part of a rotation by external air pressure, due to the withdrawal of air from the interior of the cylinder by an exhaust fan. At the side of the press is a large and slow-running shaft with a projecting end having a key fitted to it, which portion of the shaft and the key seemed to an observer to have no purpose. Upon inquiry it was found that when this press had been built the idea was to drive the fan (at a speed of about 4,000 turns a minute) from this slow-running shaft, putting in the necessary gear train to accomplish it. Gears were actually constructed for this, with the result that the press could hardly be driven at all, to say nothing of the fact that when for any reason it had to be run at a speed below the normal, as often happens in starting up, there was not sufficient suction to enable the delivery cylinder to perform its function because the fan speed was also reduced. Throwing away the gears and substituting a small electric motor and a belt to drive the fan independently overcame all these difficulties and made the press a success; but this had to be done by an outside engineer who had none of the traditions of the printing press works to hamper him.

Of course this is laughable, but is it not pretty certain that the man who thus showed his firm adherence to his particular traditions might have his laugh at similar things done by those who now laugh at him? How many men are there who give their minds absolutely free play, and range over the entire field of choice when studying how to accomplish a certain thing?

An Entire Steel Barrel From a Single Sheet.

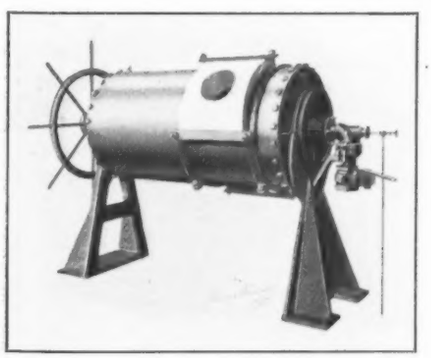
A remarkable example of advanced press work is the manufacture by a firm in the north of England, whose name is not given by *Engineering*, from which this account is taken, of entire barrels without joint or seam, welding or brazing from a single sheet of steel. At present small barrels of 5 gallons capacity are made, but the process is believed to be quite as applicable to larger sizes. As was stated, the entire barrel is in a single piece except an inserted brass bunghole ring in the middle of one head. The barrel is drawn out of a steel plate 1-24 inch in thickness, seven operations being required for its com-

pletion. The body of the barrel has the usual swell in the middle and the heads are sunk in, leaving a projecting and protecting chine. The flat plate is first drawn out into the shape of a truncated cone, and the upper portion is then gathered in, giving the proper form to the top of the barrel; the upper edge of this is then bent over, and flattened down to form the upper head of the barrel. The whole of this work is accomplished without crumpling the metal, the thickness of which is maintained constant throughout the lower half of the barrel, but in the upper half increases in thickness in proportion to the amount of reduction made in the diameter at various points during the final operations. The thickest part is that where the brass bung-hole ring is soldered in, where the metal is about ⅛ inch thick. This thickening here is of course a positive advantage.

Some New Things.

MELTING FURNACE.

This furnace is designed more particularly for brass melting and consists of a sheet-steel drum which is provided with cast-iron heads and lined with fireproof tile. There is an opening originally at each side of the drum, one of these being closed with fire-clay while the other is in use. This extra opening increases the life of the lining, as it has been found that the greatest wear comes at the charging hole (which also serves as an outlet for the flame), and when the material at this point is worn out, the opening may be closed by a fire-clay filling and plate, the furnace reversed and the opposite hole cut out and put into service. The oil burner connection and the connections for air are shown at the end of the furnace. It is

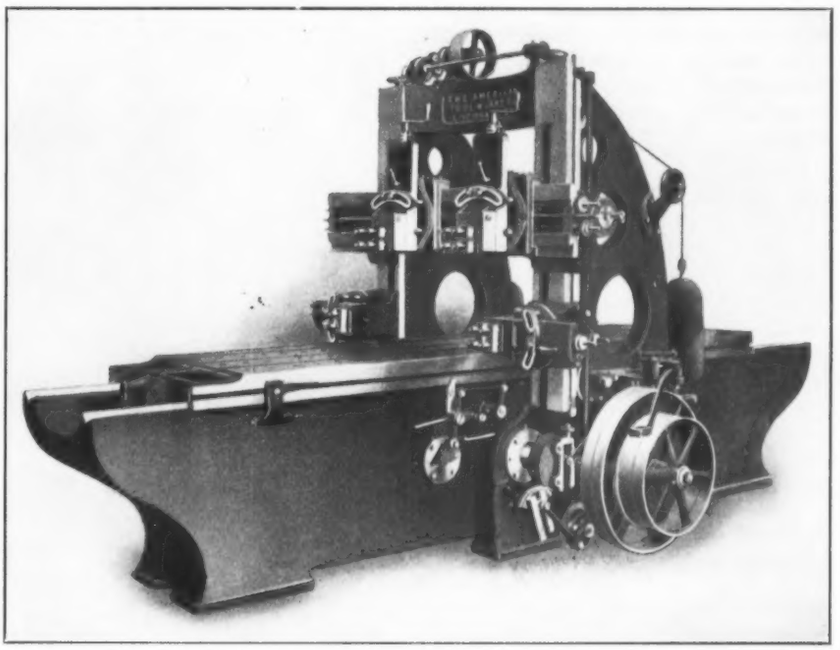


MELTING FURNACE.

stated that with this furnace six or seven heats, averaging 550 pounds each, may be made in ten hours, the consumption of crude oil varying from 2 to 2½ gallons per 100 pounds of metal melted. The furnace is made in two sizes, the smaller having a capacity of 550 pounds and the larger a capacity of 1,200 pounds of metal per heat. The makers are the Lunkenheimer Company, Cincinnati, Ohio.

PLANER.

This is one of a line of planers recently re-designed to adapt them to the heavier duties imposed by modern shop methods. The depth and length of bed are increased, the central portion where the strain is greatest is reinforced, and box girts at short intervals give the bed increased rigidity. The belt-shifting mech-

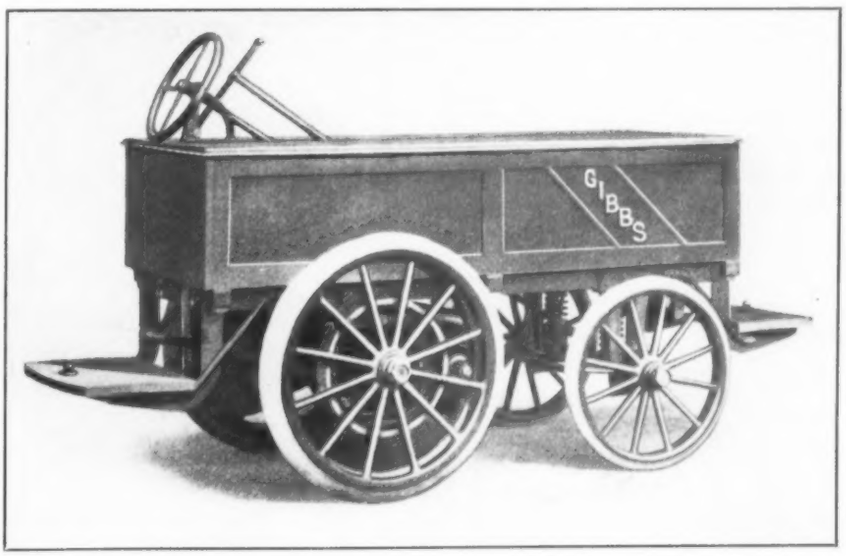


PLANER.

anism, the power elevating gearing for the rail, the feed gear, etc., are clearly shown. The heads on the rail and the side heads have separate feeding mechanism; the feeds may be operated from either side; a safety locking device prevents the platen from starting accidentally. The American Tool Works Company, of Cincinnati, Ohio, are the builders.

STORAGE BATTERY TRACTOR FOR THE SHOP.

This tractor is designed for hauling material around large plants and yards, and has a very wide radius of action, as it requires no tracks, but may be operated on wood or cement floors or on any kind of ground which is firm and reasonably level. As for the cars or trucks which it is arranged to draw, these may be run either on tracks or directly on the floor or ground. The wheels are equipped with solid rubber tires, and the drivers are separately driven by General Electric motors connected to the wheels by spur gearing, the controller, which is of the series-parallel type, being operated by the lever pivoted at the top and near the rear of the body where it is within convenient reach of the operator as he stands on the foot-board. The steering is accomplished by means of the hand-wheel, and the brake which is applied to the drivers is operated by pressure on the foot lever shown below

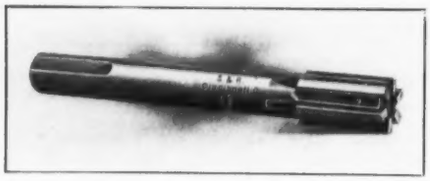


STORAGE BATTERY TRACTOR.

the body. The battery capacity is sufficient for a full day's work, and charging may be done at night or at odd moments. The tractor has a framework of steel channels reinforced to endure shock, and is 9 feet 6 inches long over all, its width being 3 feet 10 inches. The maximum speed of the tractor is 6 miles per hour. The drawbar pull is 600 pounds, the turning radius 8 feet and the weight complete 3,900 pounds. The builders are the Gibbs Engineering & Manufacturing Company, Glendale, L. I.

ADJUSTABLE BLADE CHUCKING REAMER.

This chucking or roughing reamer has a machine steel body milled, as shown, to receive the interchangeable cutters or blades, which are of high-speed steel. The front side of each blade has a groove milled near the bottom and parallel to it, thus forming a ledge upon which the points of the screws bear. As will be seen, the screws need not be moved to adjust the blades, unless preferred. The tool is intended to be used in cored work where considerable stock is to be removed without preliminary boring. The heels of the blades are sufficiently relieved to clear themselves properly, and the ends are

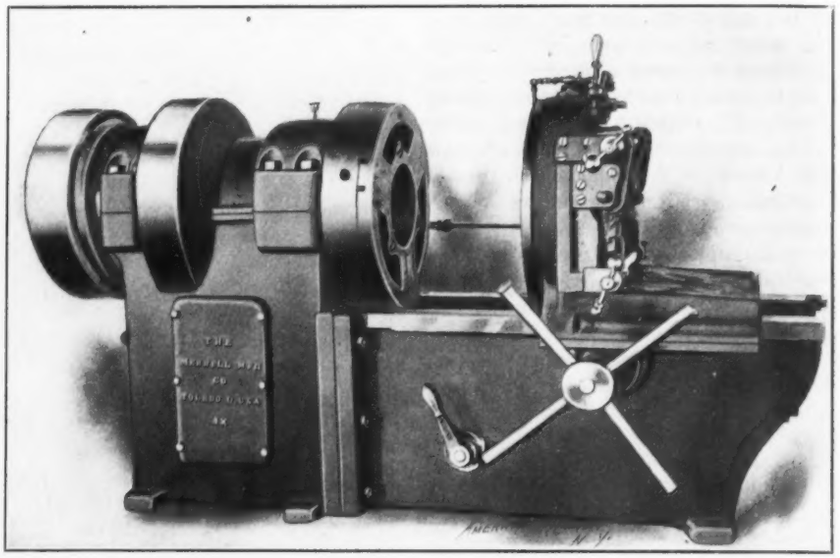


ADJUSTABLE BLADE CHUCKING REAMER.

ground square and will cut to their bottoms; thus a 1½-inch reamer will remove ¾ inch of stock at one cut. Adjustment for end wear is made by driving the blades forward. The reamers are made in sizes from 1 to 12 inches diameter (the larger sizes being of the shell form) by Schellenbach & Radcliffe, Cincinnati, Ohio.

PIPE THREADING AND CUTTING-OFF MACHINE.

This machine is one of a line built for handling large sizes of pipe. The head and column are cast in one piece, which is bolted to the bed, as shown; and the gearing, which is entirely enclosed within the head, is so arranged as to give a separate speed for each size of pipe within the range of the machine. The speed of the spindle is controlled by the lever shown at the front of the bed, and by moving this lever the operator can change his speed while the machine is in motion, and after threading at one speed cut off at another. The universal chucks on both ends of the spindle are alike, and projecting jaws are furnished for holding flanges for making up pipe. The dies are opened and closed by means of a cam ring which is operated by a pinion and hand lever. In setting the chasers this lever is released from the cam ring pinion and the latter turned until the cam closes the chasers to the size of pipe to be threaded, when the clamp nut on the hand lever is again tightened. This geared cam ring and pinion admit of the opening of the chasers when engaged in threading without forcing the die on the pipe. The cutting-off tools are two in number, located on opposite sides, so that both cut at the same time, and the die head can be moved out of the way of these tools to allow them to operate close up to the chuck. The chasers are of heavy stock of sufficient width to allow a proper taper to be obtained for the full length of a standard thread. The Merrell Manufacturing Company, Toledo, Ohio, builds this machine.



PIPE-THREADING AND CUTTING-OFF MACHINE.

AN ENGLISH SPEED-REDUCING GEAR.

The accompanying illustrations show a speed-reducing gear, intended more especially for connection with electric motors, which is the product of Joseph Baker & Sons, Limited, of Willesden Junction, London, England. Fig. 1 shows the gear as attached to a motor, Fig. 2 shows the internal parts and Fig. 3 shows an elevation and section. Referring to the last illustration a pinion *a* upon the motor shaft *b* meshes with three planet gears *c*, which in turn mesh with the internal ring gear *d*. This ring gear *d* may or may not revolve, according as it is not or is held by the band-brake *e*, which is controlled by the hand-wheel *f*. Planet gears *c* are carried in a cage *g*, better shown in the left foreground of Fig. 2, and drive a similar but smaller set of gears *h* upon the same shafts. Gears *h* in turn mesh with annular gear *i*, which drives the member *j* and through it the shaft *k*. Assuming the band-brake *e* tightened and ring gear *d* fixed, it is clear that gears *c* with their cage will revolve upon the axis of the machine, carrying gears *h* with them.

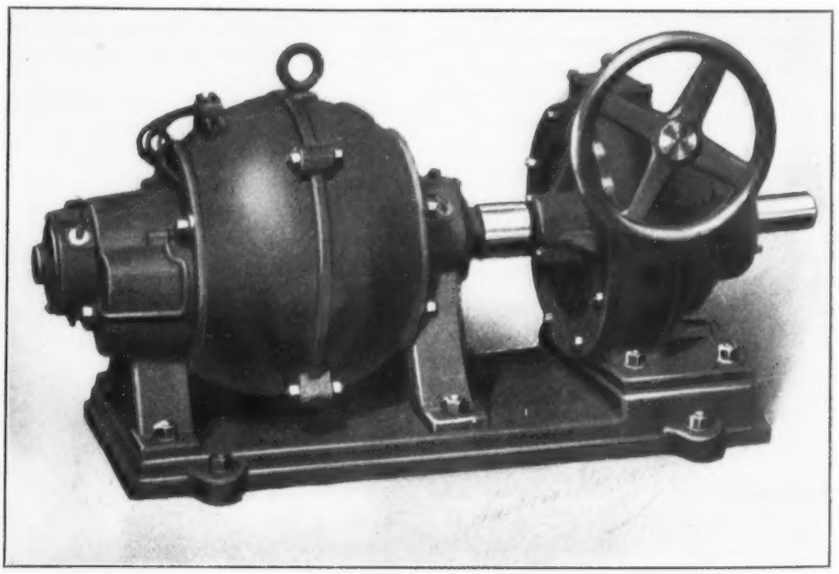


FIG. 1. ELECTRIC MOTOR FITTED WITH SPEED REDUCING GEAR.

Were gears *c* of the same size as *h*, the latter would revolve idly within *i* and no motion would be transmitted. Gears *h* are, however, smaller than *c*, and a slow differential motion is thus imparted to *i* and ring gear *d* will revolve. Other patterns of the gear contain two sets of gears *c* of different sizes, two ring gears *d* and two band-brakes. By this means two speeds may be delivered, and by a third set

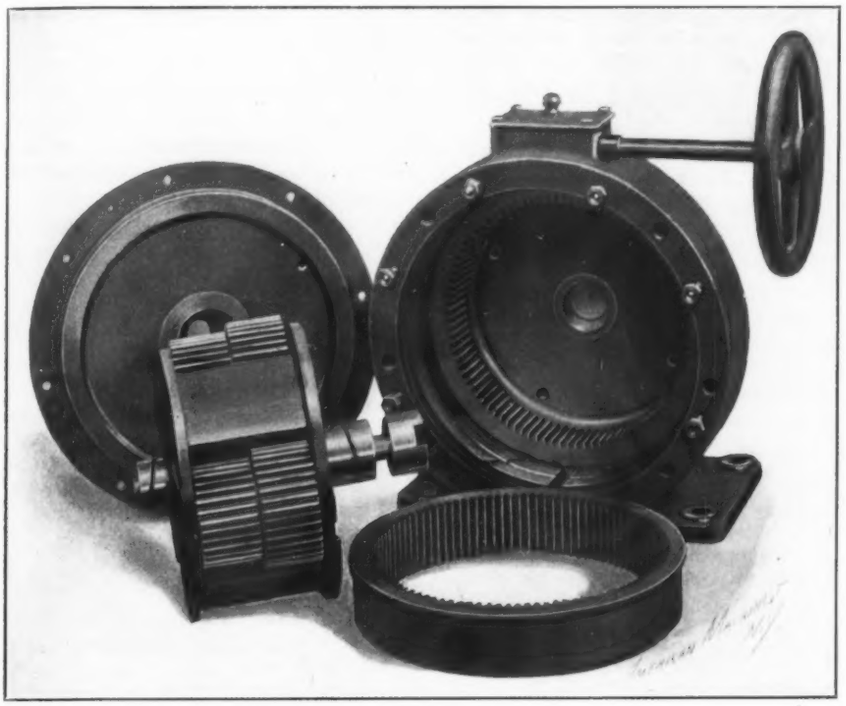
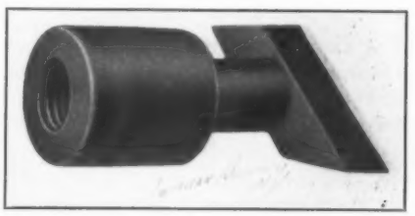


FIG. 2. INTERNAL PARTS OF SPEED REDUCING GEAR.

and *j* and through them to shaft *k*. On the other hand, if the band-brake is loosened, the resistance of the machine to be driven will hold *j* and ring gear *i* from revolving, the cage and planet gears will revolve within it as a stationary member of gears the motion may be reversed in direction.

T-HEAD FOR BOLTS.

The half-tone shows a stub T-head for a bolt the convenience of which will be appreciated by the mechanic. These heads are drop-forged and case-hardened and, as will be seen by the cut, are so shaped as to fill the T-slot and not slip when given a half turn. On machines equipped with these heads it is only necesary to thread up any number of studs of any length in the bolt cutter and screw one end of a stud into a T-head, the other end being threaded for the nut as usual. The heads are made of different sizes to fit all standard machines and are tapped for



T-HEAD FOR BOLT.

studs ranging from ½ to 1⅛ inches in diameter. They are made by the G. R. Lang Company, Cincinnati, Ohio.

A Quick Job of Marine Engine Repairing.

Engineering, London, gives an account of a repair job done at the Northam Iron Works, Southampton, on the steamship "Ninevah." This vessel arrived in Southampton Water on Wednesday, January 6, with a fractured intermediate cylinder. A Board of Trade and Lloyd's Survey was held on board the following morning, when it was decided to bore out the cylinder and fit in a cast-iron liner, together with long vertical stays to strengthen the fractured parts of cylinder. This work necessitated the turning down of the old

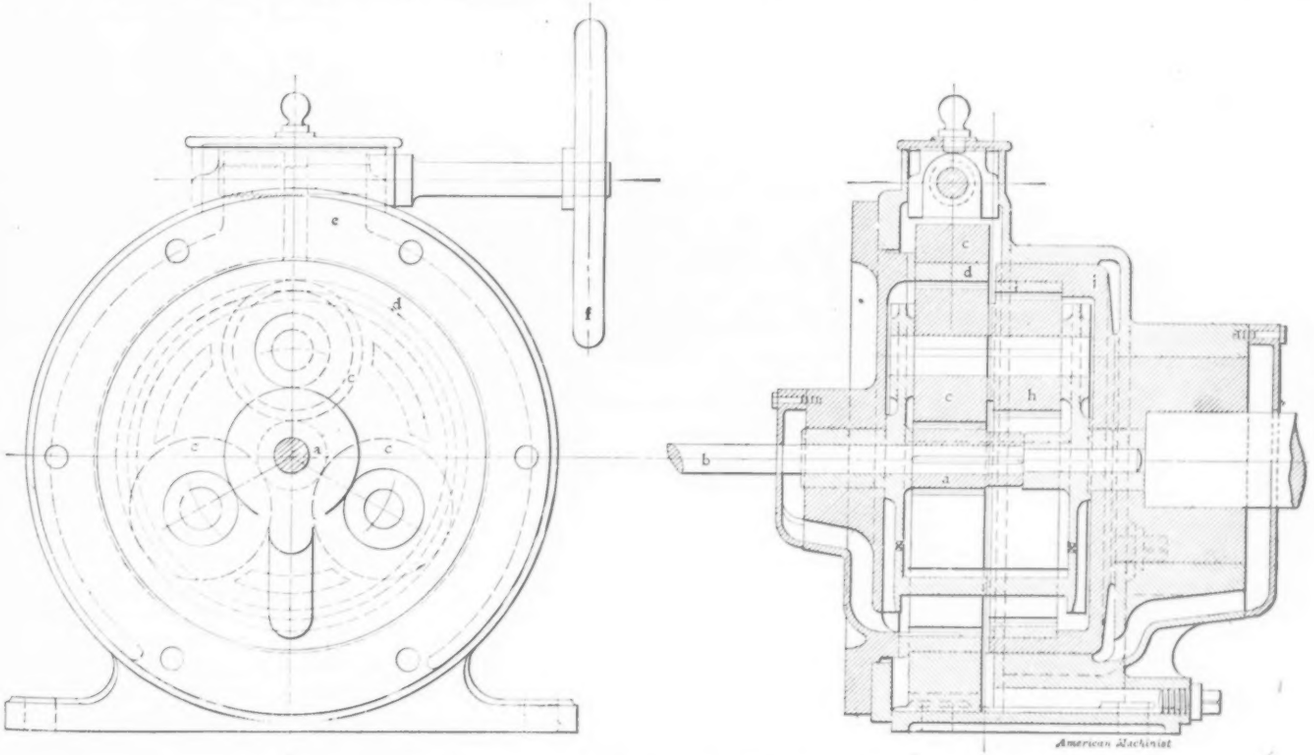


FIG. 3. ELEVATION AND SECTION OF SPEED-REDUCING GEAR.

piston, and fitting the same with new junk ring, floating ring and packing rings. The liner was cast, bored out, and fitted in place, and the vessel left on her voyage to the Cape and Australia at 8 o'clock on the following Friday morning, January 15; the whole work being carried out in seven days from the commencement, to the entire satisfaction of the company's officials and the surveyors. The cast weight of the liner was over 2 tons.

A Book About Twist Drills.

The Cleveland Twist Drill Company, of Cleveland, Ohio, has issued a little book called "Twist Drills, Their Uses and Abuses," in which is a lot of information about twist drills in general, the principles of their making and use, together with useful pointers on how to grind and use them to the best advantage in the various metals and under various conditions. The book is in no sense a catalog, but a small illustrated treatise on the practical use of twist drills. Everyone who uses those tools, or may use them, should have a copy, and the Cleveland Twist Drill Company inform us they will send it free to whoever asks for it. It is well worth sending for.

Technical Publications.

"Free Hand Lettering." By Victor T. Wilson. 95 6x9-inch pages with 13 full page plates and 9 text cuts. John Wiley & Sons, New York. Price $1.

This book treats of lettering as a matter of design rather than mechanical construction. It gives helpful analyses of the various letters and shows some things to be avoided. We must say, however, that the surfeit of books on this subject take it altogether too seriously. While clear lettering of mechanical drawings is important, the books on the subject magnify it beyond all reason.

"Machine Design—Part II. Form, Strength and Proportions of Parts." Third revised edition. By Forrest R. Jones. 426 6x9-inch pages with 243 illustrations. John Wiley & Sons, New York. Price $3.

This third edition contains about eighty added pages. The book will impress most machine designers as unnecessarily mathematical, but no one will fail to recognize the value of the large amount of information which has been obtained from manufacturers and which appears in the forms of tables, diagrams and detail drawings. The section on flywheels is, in this respect, especially full.

"American Compound Locomotives." By Fred H. Colvin. 142 5½x8-inch pages, with 42 illustrations. The Derry-Collard Company, New York. The Locomotive Publishing Company, Limited, London. Price, $1.50.

This book contains a lot of information for locomotive men. The leading makes of compound locomotives are very clearly illustrated and described, companion cuts being used for showing the intercepting valve in the simple and compound positions, together with illustrations of the slide or piston valves and other details. In addition to this descriptive matter, chapters are devoted to locating blows, breakdowns, reducing valves, drifting and disconnecting. The entire book is very practical and useful and, in accordance with the general practice of the publishers, will be sent to any address on approval.

"The Polar Planimeter and Its Use in Engineering Calculations." By J. Y. Wheatley. 114 6x9-inch pages with 12 folded plates. Keuffel & Esser Company, New York. Price, $3.00.

Of this book it may be truthfully said that it fills a long-felt want. Like the slide rule, the planimeter received due appreciation in Europe long in advance of such appreciation here. True, its use for measuring indicator diagrams, for which special forms of instrument have been made, is here very common, but its general use for the many other uses to which it is equally adapted has been strangely neglected. This no doubt is largely due to the absence of suitable literature treating of the instrument, and it is this literature which it is the author's object to supply. While, of course, the theory of the instrument is explained, the book is not, primarily, a treatise but an office manual. Tables which have heretofore been lacking in English, for adjusting the instrument for the solution of many problems are given, actual problems are worked out and the methods of adjusting and using the instrument are explained. While we could wish that greater attention had been given to the problems of the mechanical engineer, one cannot expect too much of any author and the book, from any standpoint, is an excellent one.

For a New Trade-Mark Law.

Our attention has been called to a bill now before Congress making radical changes in the present law and practice relating to trade-marks. The necessity for a change in the law is emphasized by a recent decision of the United States Supreme Court in which it is held that the present statutory trade-mark privileges inure only to marks on goods used in foreign commerce or in commerce with Indian tribes. It is pointed out that probably four-fifths of the commerce of the United States is interstate commerce—that is, goods made, imported or sold, at some time cross one or more State lines. The common law is practically inoperative for the protection of trade-marks beyond a single State, and it is believed to be very desirable, therefore, and almost essential, to place trade-marks on an interstate footing and bring all trade-marks used in "commerce among the several States" under Federal statutory protection.

The bill provides for a Bureau of Commercial Registration in the Department of Commerce, thus taking the matter entirely out of all connection with the Patent Office. The registration fee for a trade-mark is to be $15 and the privilege is to run fifteen years, being repeatedly renewable on the original terms. The trade-mark privilege is in the bill defined as follows: Any person who shall reproduce, counterfeit, copy, or colorably imitate any trade-mark registered under this Act and affix the same to merchandise, or substantially the same descriptive properties as those described in the registration, or shall otherwise use said mark in commerce as herein defined, shall be liable to an action on the case for damages for the wrongful use of said trade-mark at the suit of the owner thereof; and the party aggrieved shall also have his remedy according to the course of equity to enjoin the wrongful use of such trade-mark used in foreign commerce, or commerce among the several States, or with the insular or other possessions of the United States, or with Indian tribes, as aforesaid, and to recover compensation therefor in any court having jurisdiction over the person, firm or corporation guilty of such wrongful act; and courts of the United States shall have original and appellate jurisdiction in such cases without regard to the amount of controversy.

The Metric System Before Congress.

At the hearing of the House Committee on Coinage, Weights and Measures held February 4, protests against the passage of the pending metric-system bill were made by William Sellers, of Philadelphia; Henry R. Towne, of New York, and W. J. Warrener, of Federal, Ohio. In addition to a protest in the name of the Yale & Towne Manufacturing Company, Mr. Towne appeared as a delegate to present a protest of the Merchants' Association of New York.

Remember the New York monthly meeting of the American Society of Mechanical Engineers at the Society House, Tuesday evening, February 23.

The Society of Automobile Engineers was organized in New York, January 19. It will be conducted on lines similar to the American Society of Mechanical Engineers, and the following officers were elected: President, A. L. Riker, Bridgeport, Conn.; first vice-president, Henry Ford, Detroit; second vice-president, John Wilkinson, Syracuse; secretary and treasurer, E. T. Birdsall, New York.

Personal.

W. L. Cheney, of Meriden, Conn., is now with the Lucas Machine Tool Company, Cleveland, Ohio.

H. A. Norton, of the "Norton Jacks" (Boston) sailed on the steamer "Canpoic" January 30 for the Mediterranean and a

trip up the Nile. He expects to be gone four months.

Thomas M. Brown, who has been president and director of the American Foundry & Machine Company, of Hanover, Pa., has left his position with that company and disposed of his interest in it.

Frederick A. Waldron, Stamford, Conn., has opened an office as consulting engineer and will devote his attention to the design, installation, organization and operation of power equipment and distribution, with special reference to the steam turbine.

John McGeorge, consulting engineer of the Wellman-Seaver-Morgan Company, who has been connected with the Wellman interests as mechanical engineer for over thirteen years, has resigned, to take effect March 1. After that date he will be located at 501 Citizens Building, Cleveland, Ohio, under the name of McGeorge & Sons, taking into partnership with him his sons. He expects to do general consulting business, paying particular attention to power plants and the engineering side of office buildings. Ernest McGeorge, at present with the Wellman-Seaver-Morgan Company, will resign at the same time to become a member of the new firm.

Obituary.

John Leonard Kebler, vice-president and general manager of the Ward Leonard Construction Company, Bronxville, N. Y., died in New Mexico, February 2. Mr. Kebler was a graduate of Columbia University, class of 1900, and a member of the American Institute of Electrical Engineers.

John Casson, a locomotive machinist and engineer, died at Paterson, N. J., February 2, eighty-five years old. He came to this country from England when fifteen years old and two years later he entered the employ of Rogers, Ketcham & Grosvenor and worked on the first locomotive turned out by that firm. He afterwards worked on locomotives in Newark and Philadelphia, later had charge of all the engines of the Central Railroad of New Jersey, and in 1852 became an engineer on the Erie, where he stayed until his retirement.

New Corporations.

White-Mylin Furnace Company—Principal office, 65 Nesbit street, Newark, N. J.; objects, manufacture furnaces, boilers, etc.; capital, $5,000. Incorporators: Lewis B. White, Jersey City; Amos H. Mylin, Lancaster, Pa., *et al.*

Manufacturers.

Additions are to be made to the Philadelphia mint.

The New Freedom (Pa.) Wire Cloth Company will rebuild.

The Humboldt (Tenn.) Cotton Mills will double their plant.

Youngman & Reese, Nashville, Tenn., are to establish a sawmill.

The Eilers Piano House, Portland, Ore., is to start a new factory.

The Parkesburg (Pa.) Iron Company will build a tube and pipe mill.

The Southern Railway is about to enlarge its shops at Spencer, N. C.

It is reported that Park Bros. will build a machine shop at Storm Lake, Ia.

J. A. Wilson, of Spencer, Ia., may establish a brick and tile plant at Clarion.

The Wyoming Cutlery Company, Wilkesbarre, Pa., has enlarged its plant.

The Goeller Iron Works, Newark, N. J., are about erecting a shop building.

There have been voted $100,000 bonds for a new electric plant at Hannibal, Mo.

The factory of the Burlington (N. C.) Coffin Company has been damaged by fire.

A Chicago, Ill., building of the Pittsburgh (Pa.) Plate Glass Company has been burned.

The Louisville (Ky.) Fire Brick Works, at Highland Park, a suburb, have been burned.

The Tuhey Canning Company's factory at Muncie, Ind., has been badly damaged by fire.

The Muncie (Ind.) Gas Engine & Supply Company has arranged to erect a new building.

The Hilles & Jones Company, Wilmington, Del., is making arrangements to enlarge its plant.

G. W. Meyer is at the head of a movement to build another cotton mill at Meridian, Miss.

An engine at the power-house from which Jackson, Ky., is lighted has been blown to pieces.

The T. F. Tuttle Silver Company, Boston, Mass., intends to open a branch plant in Malden.

Vanderbeek & Sons, Jersey City, N. J., are soon to erect a large planing mill and box factory.

The Kelly Springfield Road Roller Company, Springfield, O., is making plans for an addition.

The Franklin Brick Company, Columbus, O., has bought land for a plant in Jefferson township.

The Southwark Scale Company, of Philadelphia, Pa., will build a new plant in Camden, N. J.

The Alcorn Woolen Manufacturing Company, of Corinth, Miss., has decided to double its plant.

The Siluria Cotton Mill Company, which is completing a mill at Siluria, Ala., will double its capacity.

It is stated that the Santa Fe Company proposes to enlarge its shops in San Bernardino, Cal.

The Clinton (N. Y.) Electric Company may install a steam plant as an auxiliary to the water power.

Adolphus Busch, of St. Louis, Mo., will erect a 28-ton-a-day artificial ice plant in Emporia, Kan.

D. A. Fluker, of Detroit, Mich., has been at Dowagiac organizing a company to manufacture brick.

The Washington Parlor Furniture Company, Tacoma, Wash., is establishing a good-sized factory.

E. E. Dobbins, Jennings, La., will have a new machine shop ready in a few weeks, to replace a burned one.

The Tanners' Supply Company, Grand Rapids, Mich., thinks of spending $250,000 on an extract factory.

The Swab Wagon Company, wagons and agricultural implements, Elizabethville, Pa., will enlarge its plant.

Murray & Thomas, Maysville, Ky., will enlarge their marble works and install new pneumatic machinery.

The plant of the Gavitt Manufacturing Company, maker of paper caskets, Shell Lake, Wis., has been burned.

The plant at Martin's Ferry, O., of the Riverside Bridge Company, Wheeling, W. Va., has been damaged by fire.

A. J. Shellman, of Grand Rapids, Mich., contingently plans to build an optical lense grinding plant at Cascade.

A serious fire is said to have occurred at the wood-working plant of the Hall & Munson Company, Bay Mills, Mich.

A plant is to be built by the Fremont (O.) Pressed Brick & Manufacturing Company. The president is Dr. A. F. Price.

Andrew Kimble will build at Zanesville, O., a shop for use in the manufacture of his interchangeable summer-winter cars.

The Wichita (Kan.) Planing Mill has bought a site for new buildings. Some additional machinery will be installed.

The New Haven (Conn.) Clock Company has bought adjoining land, 40x100 feet. An addition to the plant is thought of.

The plant of the Dutton Engineering Company, manufacturer of gasoline launches, Perth Amboy, N. J., will be enlarged.

Schutte & Koerting Company, machinery manufacturer, Twelfth and Thompson streets, Philadelphia, will build an addition.

The William J. Hooper Manufacturing Company, Baltimore, Md., has purchased a site for a netting and cordage plant.

Preliminary plans have been made for a boiler-house for the E. J. Codd Company, engineers and machinists, Baltimore, Md.

According to a statement at Youngstown, O., it is intended to improve the plant of the Morrison Foundry & Machine Company.

A permit has been issued for a two-story repair shop, 45x154.8 feet, for S. Liebmann's Sons Brewing Company, Brooklyn, N. Y.

C. M. Streiby, of Philadelphia, has been in Chester, Pa., looking for a site for a rotary engine establishment, which he represents.

Maulbetsch & Whittemore, manufacturers of musical instruments and boxes, Nashville, Tenn., have bought a site for a new factory.

The destroyed portion of the plant of the Chicago Steel Manufacturing Company, Hammond, Ind., will be rebuilt on a larger scale.

Henry S. Wilson, of the Wilson Cypress Company, Palatka, Fla., and F. S. Hodges, of Hastings, may build a lumber mill at Hastings.

The Lalance & Grosjean (Agate Ware) Manufacturing Company, New York city, has secured land adjoining its plant at Woodhaven, L. I.

The St. Clair Hydraulic Stone Company, East St. Louis, Ill., is about to build a factory; motive power electricity generated at the plant.

A bill has been introduced in Congress granting permission to the Davenport (Ia.) Water Power Company to build a dam and power station.

The Merrimack Manufacturing Company, of Lowell, Mass., and elsewhere, will, it is reported, build another big cotton mill near Huntsville, Ala.

A large beveled glass factory near Louisville, Ky., will be remodeled and placed in operation by Col. A. S. Berry, of Newport, Ky., and another.

The Bridgeton Bleach & Finishing Company is soon to be established at Bridgeton, N. J., under the auspices of W. P. West & Son, Philadelphia.

At the annual meeting of the Industrial

Bureau, Cincinnati, A. J. Conroy stated that a large furniture factory proposed to locate there in the spring.

The Haberkorn Engine Company, Fort Wayne, Ind., expects to spend $12,000 in improvements this year, mostly on a building for erecting purposes.

The Zoffer Plate Glass Company, with a capital of $750,000, will build a factory at Charlerol, Pa. Henry Zoffer, a Charlerol merchant, is president.

The Grand Haven (Mich.) Basket Company proposes to locate a branch plant in Alabama. A planing mill will be added to the Grand Haven plant.

It is stated at Columbus, O., that the board of penitentiary managers will ask the legislature for a $40,000 appropriation for an electric lighting plant.

The C. S. Garman Company, composed of C. S. Garman, of Long Green, Md., and others, is incorporating to manufacture spokes, hubs and wheels at Hanover, Pa.

The Houston (Tex.) Lighting & Power Company has ordered a 1,500-kilowatt generator, driven by a vertical steam turbine, besides other power equipment.

A bill has been introduced into the Virginia Senate appropriating $25,000 for a plant to heat and light the capitol, the executive mansion and the State library.

The Twentieth Century Manufacturing Company, Portsmouth, O., composed of H. A. Bierley and others, is entering the manufacture of a washing machine and churn.

A two-story, 100x140-foot foundry building at Fillmore street, near Rockwell, Chicago, Ill., has been leased for a long term to the Francis & Nygren Foundry Company.

The Brockport Wagon Company (capital, $25,000) has been formed at Brockport, N. Y., and will build a plant. The president is Samuel Howell; manager, A. E. Furney.

A company is likely to be organized to build a gray, and perhaps malleable, iron foundry at Springfield, O. Among those concerned is David Brennan, of Detroit, Mich.

It is stated at Los Angeles, Cal., that Architects Morgan & Walls have prepared plans of a power-house for the Kern River Power Company, to be three stories, 100x75 feet.

Permits have been issued to the National Wire Corporation, New Haven, Conn., on the construction of several new buildings for the manufacture of wire, wire nails, etc., in Fair Haven.

The Millfort Mill Company and the Fort Mill Manufacturing Company, both of Fort Mill, S. C., and under the same management, think of substituting electricity for steam power.

David H. Fritts, of D. H. Fritts & Co., manufacturers of moldings and picture frames, Chicago, Ill., has purchased a site which will eventually be improved with a factory.

The Holt Manufacturing Company, manufacturer of wheels, harvesters, etc., Stockton, Cal., is about to build an additional plant at Walla Walla, Wash., where it already has a branch.

Citizens of Rothsville, Pa., and vicinity propose to build a canning factory. Ed. D. Seidomridge and Noah Hess, of Rothsville, and W. S. Stauffer, of Disston, are the Executive Committee.

C. F. Janes, of Chattanooga, Tenn., and others think of reorganizing the Twentieth Century Disc Plow Company, of Chattanooga, Tenn., to establish a plow factory at Muskegon, Mich.

There is a report at New Paris, O., that W. H. Alford and others, of Richmond (Ohio, evidently), are organizing a company to manufacture a patent nut lock invented by Charles Border.

The Smith-Wallis Iron Works, Houston, Tex., will enlarge its capacity. J. W. Snyder, vice-president, has gone East and is studying plans and methods as well as buying new machinery.

The Ridgway Machine Tool Company, Ridgway, Pa., will occupy several months longer before its plant is regularly started. Most of the big tools for the plant are to be built on the ground.

E. L. Grimm, of Buffalo, N. Y., and George Saxer, of Lopez, Pa., have been at Wyalusing, Pa., tentative to securing a site and interesting capitalists there in forming a company to manufacture automobiles.

The proprietors of the jewelers' wire factory that, as already announced, has arranged to locate at Ossining, N. Y., are Royle & Akin, of Newark, N. J. They also make wire for various other purposes.

Chartered with a capital of $10,000, the People's Light, Heat & Power Company will erect a plant and furnish light, heat and power for Mahanoy township, surrounding Shenandoah and Mahanoy City, Pa.

The Western Pulp & Lumber Company contemplates establishing a plant in the vicinity of Kamloops, B. C. C. B. Pride, of Appleton, Wis., seems to be connected with the project as engineer or otherwise.

The Gay & Ward Company, Inc., of Athol, Mass., and the Superior Tap Company, of Springfield, Vt., have opened offices at 17 Warren street, New York city, in charge of W. H. Carlisle and F. M. Van Gelder.

J. W. Stephens, representing the Yansey process for the treatment of ores, recently visited El Paso, Tex., from Denver, Colo., with a view to possible establishment of a factory at El Paso for building the plants.

It is stated that the seven-story factory of the Russell & Erwin branch of the American Hardware Corporation, New Britain, Conn., is to be added to this year. The building is used by the Corbin Motor Vehicle Company.

Plans and specifications for a new wagon factory for the South Bend Wagon Company, which recently moved from Mishawaka, Ind., to Fort Smith, Ark., were lately being prepared by Architect George Selby, of South Bend, Ind.

The Crocker-Wheeler Company, manufacturer and electrical engineer, announces that its Chicago office has established headquarters for Western Ohio at 1232 Union Trust Building, Cincinnati, with H. A. Brown as representative.

The Board of Trade, Wilkesbarre, Pa., is in communication with a Mr. Grawal, of Denver, Colo., who talks of establishing a large plant there to make mining and smelting machinery. The plan bids fair to materialize quickly.

J. T. Fyans, of Fall River, Mass., and A. F. Knight, of Providence, R. I., have conferred at New Orleans with W. B. Rogers, president of the Interstate Trust & Banking Company, regarding organizing a cotton mill company for Laurel, Miss.

The plant of the Hood Machine Company, at Birmingham, Ala., has been purchased by J. R. McWane, of Virginia, and W. T. Adams, of Corinth, Miss. The plant will continue in operation and a steel casting plant will be added.

An increase from $1,000,000 to $2,000,000 in the capital stock of the J. I. Case Threshing Machine Company, Racine, Wis., is due to increasing business, necessitating the building of large warehouses at Minneapolis, Oklahoma and elsewhere.

According to a report from Terre Haute, Ind., the contract for building of the Gartland Iron Foundry has probably been let by this time. We understand that this is to be a Terre Haute foundry, but that Mr. Gartland is now at Marion, Ind.

M. Garland, of Bay City, Mich.; Thomas H. Springer, of Waterloo, Ia., and W. H. Rainsford, of Philadelphia, are fitting up a plant at Bay City to manufacture the Springer cream separator. The machinery has probably been secured by this time.

Pittsburgh capitalists have formed the Burton Powder Company with a capital of $150,000, to make powder and dynamite. Grading has begun for works at Quaker Falls, Pa., about a mile east of Lowellville, O. Electricity will be used for motive power.

It is said that besides the expenditure of over $1,000,000 in new freight cars, the Queen & Crescent Route is arranging to enlarge the car repair shops at Ludlow, Ky., and build new shops at Chattanooga, Tenn., involving an expenditure of about $200,000.

The American Zinc & Chemical Company has just been incorporated and will invest $200,000 in an ore-treating plant near Denver, Colo. Among the people interested is C. E. Dewey, mining engineer and president of the Denver Ore Purchasing & Smelting Company.

The United States Mica Company, which, a Colorado paper says, is composed of "Pennsylvania railway magnets," will build a mica factory at a new town to be called Michanite, in the western part of Fremont County, Colo. R. W. Menk is general manager of the company.

Greenlee Bros. & Co., Chicago, Ill., manufacturers of wood-working machinery, are planning for the second group of buildings at the plant they are establishing at Rockford, Ill. Among the buildings of this plant will probably be a foundry to be built some time next fall.

The Builders Iron Foundry announces: "We have completed arrangements with the d'Auria Pumping Engine Company, by which we have charge of the sales of the d'Auria pumping engines, compressors and blowing engines. We shall build these engines and compressors in our shops at Providence, R. I."

Arrangements are being made by which, it is expected, the Indianapolis Watch Company, capitalized at $600,000, will be established at Indianapolis, Ind. It is intended to take over the Remington Watch Company, Schweltter Watch Company and the Cam & Roy watch case plants and remove them to Indianapolis.

The business formerly conducted by J. R. Kilpatrick & Co., Bridgeport, Conn., has been formed into the Kilpatrick & Holtz Company. They will manufacture and deal in electric, gas and plumbing supplies and fixtures. The capital stock is $10,000. The company is making arrangements for the enlargement of its business.

The Elgin Suction Washer Company has applied for license to incorporate; capital stock, $40,000. Incorporators: C. A. Wetzel, J. W. Hamm and A. F. Buckner, all of Elgin, Ill. The company begins the manufacture of a patent washing machine in the Towner Building, Elgin. When the business warrants it a new factory will be erected.

It is said that improvements which may aggregate $1,000,000 are to be made on the plant of the Holthoff Machinery Company, at Cudahy, Wis., which was recently organized under the name of the Power & Mining Machinery Company. The authority for this report seems, however, to have been unable to verify it at the Cudahy office of the company.

The Edmonds-Metzel Manufacturing Company, Chicago, Ill., manufacturer of hardware and electrical specialties, sheet metal stampings, dies, tools, experimental work, electro-plating, etc., announced that on or before February 1, it would occupy its new factory, 153-159 South Jefferson street, near Jackson Boulevard. Its facilities are trebled in every respect.

The Wells Manufacturing & Supply Company has been incorporated with $25,000 capital stock and an office at 24 South Capitol street, Indianapolis, Ind. It will manufacture office, electric railway, mill and factory supplies, fireproof safes, etc. The concern is an already established one, headed by Ambrose H. Wells, and is said to have plants at Columbus, O., and Cincinnati. These may eventually be concentrated at Indianapolis, a plant being erected there to employ some 250 men, but definite plans have not been made.

The Thorson Manufacturing Company has been organized with a capital of $50,000, and will have its headquarters in Mitchell, S. D. Incorporators: Gilbert Thorson, Edward Welch, John Christopher, C. G. Christopher, all of Letcher, and O. C. Thompson, of Mitchell. The purpose of the company is to manufacture a patent cylinder wrench for threshers. John Christopher is the patentee. For the present the goods will be manufactured in the East on contract, but it is expected ultimately to establish a factory in Mitchell.

The Headson Tool & Manufacturing Company, incorporated under the laws of New York with a capital of $100,000 to manufacture several newly patented tools, among which is a pipe cutter, also an automatic pipe wrench, is establishing a plant at Lafayette, Ind. The patentee of these articles is Frank S. Headson, who will have charge of the manufacturing department. Herman and Julius Pottlitzer, of Lafayette, are identified with the enterprise. L. J. Lippman, of New York, is president. The machinery has been ordered.

The Pittsburgh Shear Knife & Machine Company has announced that its name has been changed to the Heppenstall Forge & Knife Company. The management remains the same. The Heppenstall Forge & Knife Company, forgings, shear knives, Pittsburgh, Pa., announces that it has sold its machinery business to the Erie Foundry Company, Erie, Pa., and that it (the Heppenstall F. & K. Co.) is now building a fine new forge plant, which will be fitted throughout with new hammers. All the machinery will be run by electricity. The contracts for all this machinery have been let.

The Southern Street Car Manufacturing Company is about to build a plant at Ensley, Ala. W. G. Pilkinton, of Virginia, is president, and J. W. Gilliam, of Virginia, secretary and treasurer. Both will reside in Birmingham. A two-story building, 300x300 feet, will be erected for the shops proper. The president is quoted as saying he intends to start with not less than 1,000 employees and to increase the number to 2,000 later on. The company owns a number of patents on street car devices, including the registograph. The company has offices in the First National Bank Building (Birmingham or Ensley?).

The Goldschmidt Thermit Company (president, Dr. Hans Goldschmidt, Essen-Ruhr, Germany; vice-president and treasurer, E. Stutz, New York; office, Wall Street Exchange Building, Exchange place and Wall street, New York) announces that it has incorporated under the laws of New York for the purpose of exploiting in the United States the alumino-thermic process invented by Dr. Goldschmidt and protected by United States patents, all rights under which the company has acquired. It proposes to conduct business generally in connection with the chemical and tin smelting works of Th. Goldschmidt, Essen-Ruhr, Germany (founded 1847) and is prepared to handle all products dealt in by the parent concern.

The Westinghouse Machine Company has recently received an order from Joseph Benn & Sons for a turbo-generator set to be used in furnishing light and power for driving machinery in its new alpaca mills which are to be built at Olneyville, R. I. This factory will be an American branch to its Yorkshire, England, mills. The turbine is of the Westinghouse-Parsons type, of 400 kilowatts capacity, and is to operate under a steam pressure of about 150 pounds. Superheated steam will probably be used. The turbine will drive a 400-kilowatt, three-phase Westinghouse alternator, which will deliver power to the motors situated in the various parts of the mill for the purpose of driving machinery in the different departments. A 7½x7 Westinghouse standard engine-type outfit is also being supplied and will be direct connected to the generator rig for furnishing the exciter current. F. P. Sheldon & Co., mill engineers, of Providence, are now at work designing the plans for these mills.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Stamping dies and tools designed for rapid work. Box 73, Racine Jct., Wis.

J. Gregory, 140 W. 23d st., New York, specialist in small machine designing.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Machine and brass works want a specialty to manufacture. Address R. J., care AM. M.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

We will buy, pay royalty or manufacture for patentee a patent possessing merit. Box 111, AMERICAN MACHINIST.

Fifty copies "Dies and Diemaking," at 50 cents each; slightly damaged; sent on approval. J. L. Lucas, Bridgeport, Conn.

Special machinery for reducing labor and increasing profits, designed and perfected. C. E. Sargent, M. E., 1214 Manhattan, Chicago.

Exceptional machine shop facilities; best mechanical ability; our rate 60c. per hour. Pollard-Alling Mfg. Co., 312 E. 23d st., N. Y.

A complete course in mechanical drawing is given in Rogers' "Drawing and Design," $3. Illustrated catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

Wanted—Medium weight and heavy machinery to manufacture, by large modern machine shop and foundry employing up-to-date methods. Address Box 87, AMER. MACH.

Wanted—South American agency; reliable party, resident in South America, desires to represent or act as selling agent for manufacturing or export firms. Address A. M. 122 Front st., New York.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

American engineer, established at Lille, France, desires to obtain the right to construct for some American or English firm, machinery suitable to the French trade. Watt, La Madeleine lez Lille, France.

Examinations and reports on inventions for investors, designing of detail parts for small machines and experimental apparatus, drawings, plans and specifications. C. E. Whitney, 123 Liberty st., N. Y.

Machinists will find in Rogers' Machinists' Library (3 vols., $7, payable $1 monthly) the most helpful set of home study and reference works. Illustrated machinists' catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

Want to furnish men of proved ability, as managers, superintendents or foremen, in the metal-working industries; no charge; also want men to fill such positions. For terms address James Brady, Room J, 20th Floor, 220 Broadway, N. Y. City.

Well-known designer and shop manager wishes associates with capital to build a fully developed and highly successful machine tool; good profits, based on actual knowledge of costs—no guesswork—can be shown. Address Box 153, AMER. MACH.

For Sale.

For Sale—Four complete sets of patterns with all drawings for large machine tools; will be pleased to correspond with parties wishing to take up a good line. Box 442, AMERICAN MACHINIST.

Drawings of two-cycle stationary and marine gasoline engine, 1½, 2½, 3, 4, 6, 8 and 12 H.P.; our latest design; one set only will be sold East. For particulars address Duluth Gas Engine Works, Duluth, Minn.

For Sale—Six volumes of the Transactions of the American Society of Mechanical Engineers, Vols. X to XV, inclusive; all as clean and fresh as when first issued from the press and book bindery. Address "Mechanical Engineer," care AMERICAN MACHINIST.

For sale on favorable terms, the following Bath grinders: 2 No. 2 Water without strengthening knee and tray, 5 No. 2 Water with strengthening knee and tray (our latest type) and 1 No. 1 Dry. Parties interested correspond with Loop-Lock Machine Company, Waltham, Mass.

For Sale—A machine shop in New York city (Manhattan); suitable for special machine building, automobile and general repair work. Established three years. Fully equipped with modern tools, all in first-class shape. Good location. Address R. C. Handloser, M. E., 127 Duane st., New York.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.; foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

DELAWARE.

Young man, 11 years' shop experience, now has charge and designs tools, good education, reliable, up-to-date, wants position; $100 a month. Box 113, AMERICAN MACHINIST.

ENGLAND.

Advertiser desires correspondence with a firm requiring the services of a works manager or superintendent; is at present engaged as such with electrical works in England; served one firm 8½ years in America in similar position; used to piece work; well educated; age 34 years. Apply Box 147, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Position of responsibility, by young man; 13 years' shop and drafting-room experience; up to date on appliances for turning out work rapidly; understands handling men. Box 536, AMER. MACHINIST.

NEW JERSEY.

Man, 37, who has had a large and varied experience, qualified to assume responsibili-

ties wherein a thorough knowledge of modern business methods in finance, accounting, correspondence, selling, cataloging, advertising, factory cost accounting, shop practice, etc., is required; a good road man and business getter, expert organizer and systematizer, capable of doing the work as well as directing it, familiar with small tools, machine tools, engine building and analogous lines; at present employed, is open for engagement with responsible people; parties interested please address Box 143. AM. M.

NEW YORK.

Japanese mechanical draftsman; graduate; 4 years' experience. Box 128, AM. MACH.

Mechanical draftsman, experienced, desires position. Box 142, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, wants position. Address Box 140, AM. M.

Practical draftsman, American, 26, on general machine work. Box 137, AMER. MACH.

Machinist, toolmaker on fine, accurate work, large or small; 4 years last position. Address Box 146, AMERICAN MACHINIST.

Superintendency wanted by an up-to-date man; years of experience; shop organizement of the best; would take work by contract. Box 122. AMERICAN MACHINIST.

Ad. Writer—First-class man, experienced in machinery advertising, seeks position, at good salary, with responsible company; references A1. Box 133, AMERICAN MACHINIST.

Smart, reliable, all-round machinist wants job with inventor; St. Louis exhibition, or any place where thorough, practical experience and knowledge are wanted. Box 141, AMERICAN MACHINIST.

Experienced mechanical engineer; up-to-date designer and superintendent; high-grade simple and compound engines, general machinery, etc.; open for engagement. Address Box 150, AMERICAN MACHINIST.

Machinist, tool die maker, draftsman, wants position; energetic man of brains, experienced on light, fine interchangeable work; wages no object; N. Y. city or vicinity preferred. Box 151, AMER. MACHINIST.

A first-class mechanical engineer and designer of machinery would like a position as superintendent or draftsman in New York city or vicinity; have 15 years' practical experience and can furnish the best of references; at present employed in Chicago, but would prefer to go East. Box 138, AM. M.

OHIO.

Draftsman, experienced and resourceful. M., 417 E. Columbus st., Kenton, Ohio.

Wanted—Position as superintendent or general foreman, by a thorough, practical mechanic, with 12 years' experience; age 38; member of A. S. M. E. Box 76, AM. MACH.

Experienced chief draftsman and designer of machine tools, jigs, etc., wishes permanent position as designer or assistant superintendent; best of references. Box 154, AM. M.

PENNSYLVANIA.

First-class draftsman, experienced, wants position. Box 152, AMERICAN MACHINIST.

Mechanical and electrical draftsman, a post-graduate with several years' experience as designer, wants position. Care P. O. Box 53, Wilkinsburg, Pa.

Position as manager of machine shop or foundry; experienced in buying and selling as well as general office work and detail shop management with satisfactory cost system; have large acquaintance in all sections of the United States; age 37. Box 139. AM. M.

Superintendent, general foreman or chief engineer; energetic; wide experience on high-speed or Corliss engines, 100 to 8,000 horsepower; systematic, and best modern shop methods; understands Rite's inertia governor; open for engagement. Address Box 114, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Position as foundry superintendent, by man with 20 years' experience in successfully managing men; thoroughly familiar with manufacture of heavy and light castings in all branches, machine molding and brass making; best references. Box 144, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Foreman for brass foundry in Toronto, Canada, conversant with plumbers' and engineers' goods; state experience and salary expected. Apply Box 134, AMER. MACH.

GERMANY.

For Germany—First-rate man wanted to organize and take charge of rapidly increasing machine screw department of large manufacturing concern; must be able to produce all kinds of rough and finished screws, also screw machine work, by most modern methods; applications invited from experienced men who can refer to work done in similar lines; German preferred. Address, by letter, "Germany," care AMERICAN MACHINIST.

ILLINOIS.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and core-makers; we always have vacancies. Address Allis-Chalmers Co., New York Life Bldg., Chicago.

INDIANA.

Wanted—Three first-class toolmakers; state experience, recommendations and salary expected. Apply Box 145, AM. MACH.

LOUISIANA.

Wanted—An experienced salesman in the line to take charge of the small tool and supply department of a machinists' supply house; South; state age, experience and salary. Box 108, AMERICAN MACHINIST.

MASSACHUSETTS.

Shafting-hanger salesmen wanted; only men of experience in this line need apply; give references and experience. Address Box 132, AMERICAN MACHINIST.

Wanted—A working foreman who thoroughly understands sheet metal stamping and construction of tools for same; state age, experience and wages. Address Box 112, A. M.

MICHIGAN.

Man wanted, thoroughly capable of taking charge of machine shop employing 25 to 30 men; location, Detroit, Mich. Box 135, AMERICAN MACHINIST.

Molder, young, reliable, practical, expert in metal and processes, to take charge of small foundry for light high-grade castings only; on salary and share in business. Address J. B. Allen, 94 Lincoln ave., Detroit.

NEW HAMPSHIRE.

Draftsman and designer in line of steam engines and machinery; give experience and references, age, family and pay expected. Box 86, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—A first-class lathe hand on 24 in. Gisholt lathe. Write, giving reference and salary expected. Box 136, AMER. MACH. None but experienced men need apply..

NEW YORK.

Wanted—Five (5) first-class toolmakers; will guarantee steady work and good pay; only members of Micrometer Lodge need apply. Metropolitan Sewing Machine Co., Nyack, N. Y.

Man wanted, capable of taking charge of about 30 automatic screw machines, different makes; good class of work; 9 hours per day; state fully experience, wages wanted, etc. Box 148, AMERICAN MACHINIST

Toolmaker wanted competent to take charge of 25 men in tool department of an up-to-date manufacturing concern; best machinery; no labor troubles; give full particulars, experience, age, wages wanted. Box 149, AMERICAN MACHINIST.

Every man who thinks that he can prepare good, convincing advertisements for machinery and mechanical appliances is invited to write to us and say why he thinks so. If proofs in the form of work already done come along with the letter, so much the better. We prefer a man who combines actual shop experience with facility in writing, but the all-important thing is the ability to decide which features of any given machine will most favorably impress the possible purchaser, and to put these features into the most attractive and convincing form. A good position awaits the right man. Hill Publishing Co., World Building, New York.

OHIO.

Wanted—An experienced cost-accountant, thoroughly familiar with premium systems adapted to machine shop requirements. H. W. H., Drawer T, Cleveland, O.

Wanted—By a firm manufacturing plumbers' brass goods, a first-class toolmaker capable of designing and making tools and fixtures for turret lathes. Address, with references, wages expected, etc., The Sanitary Co., Cleveland, O.

PENNSYLVANIA.

Wanted—For large engine and pump shop, non-union working foreman for each of the following departments: lathe, planer and milling machine, boring mill, and turret lathe; applicants must be well recommended as to character and skill, and be prepared to make a stand for the principles of open shop. Address E. N. A., care AM. MACH.

WISCONSIN.

Speed boss for machine shop doing medium and heavy work; steady position to competent man, with a bonus on work turned out; none need apply unless experienced in this line. X. Y. Z., care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—A competent draftsman. The Murray Iron Works Co., Burlington, Iowa.

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Gears for Variable Center Distance.—Chordal Pitch.

BY G. F. DODGE.

At page 1712, Vol. 26, there appeared an article under the title "Gears for Variable Center Distance" which calls to mind a subject which I have for some time been intending to mention, viz., "chordal pitch."

While realizing that it has a legitimate application as in sprocket wheels, I would like to see some advocate (they are not all dead yet) justify its application in other gearing. Of all the places where I have seen it used it gave anything but satisfaction.

Take the conditions given in the article referred to and, accepting the ratios given, we have the formula:

$$\text{Chord pitch} = 2\ R \sin.\ \tfrac{1}{2}\ a,$$

which, transformed, gives:

$$R = \frac{\text{chord pitch}}{2 \sin.\ \frac{1}{2}\ a}$$

in which R = pitch radius and a angle between two consecutive teeth.

Solving this we have $R = 11.9445$ inches for the gear and $R = 3.8444$ inches for the pinion.

From these pitch radii we may find the circular pitch, which is 1.50067 inches for the pinion and 1.50097 inches for the gear, giving .0087 inch difference in pitch between the two, an amount which is certainly sufficient to make the gears noisy if run even at ordinary speeds, and which will cause a sudden change of load from one pair of teeth to the next, with the assurance of rapid deterioration if not failure from the shock.

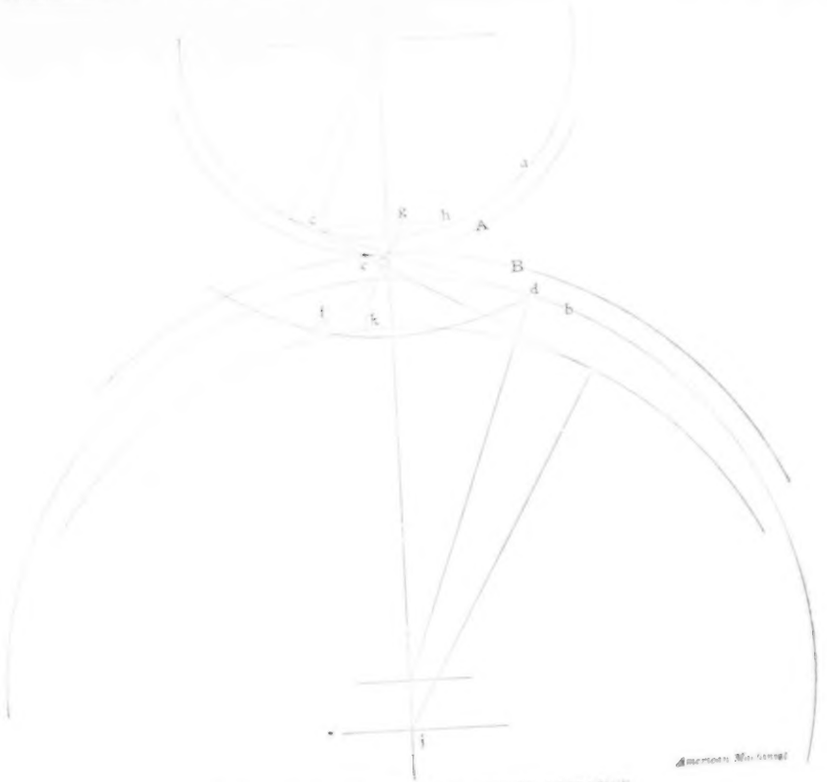


FIG. 2. GEARS FOR VARIABLE CENTER DISTANCE.

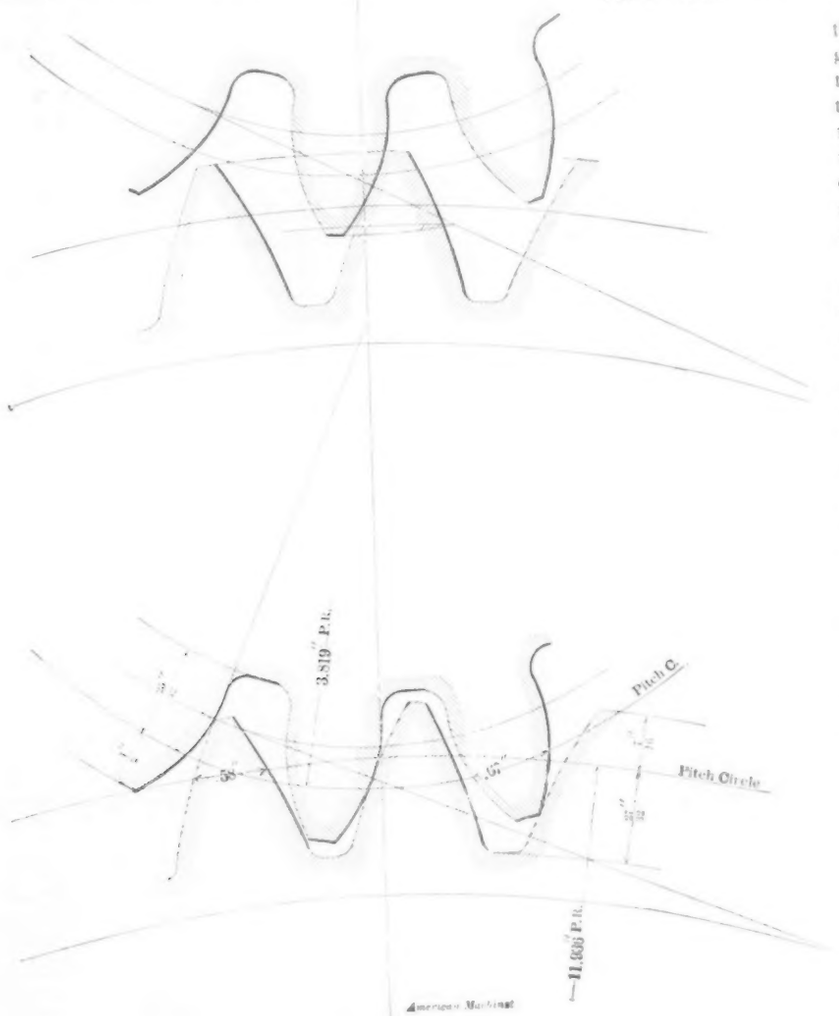


FIG. 1. GEARS FOR VARIABLE CENTER DISTANCE.

These faults are due expressly to the assumption of chordal pitch and will be aggravated or minimized as the velocity ratio increases or diminishes.

There is a point, however, in the design of the gears as shown by Mr. Wilson which seems to have been overlooked in his assumption that the gears will have a constant action when farthest apart if the point of the gear tooth crosses the line of action before the preceding pinion tooth has left it. The error lies in the fact that the gear tooth has been doctored to avoid interference and that the point, for a distance, is not an involute. There cannot be contact between the approaching gear and pinion teeth until all of this doctored portion of the curve has passed the line of action, *i. e.*, until the actual involute curve has reached the line of action, which, according to Mr. Wilson's sketch, would be too late.

Fig. 1 shows a modification of the outlines which would give the proper action, although the approaching teeth do not begin action any too soon when the centers are farthest apart. 1½ inches circular pitch is used. By increasing the angle of obliquity from 22½ to 25 degrees with the gears in normal position, all necessity of doctoring the gear teeth is removed, and

the pinion tooth is thickened to compensate for the extra 1-16 inch length which it is necessary to add to insure constant action when the center distances are greatest. An addition of .01 inch may be made to its pitch thickness, and even greater fillets than those shown may be used.

Fig. 2 shows a simple conception of the involute and its application to gearing. Consider the two pitch circles *A B* with their corresponding base circles *a b*, determined by being drawn tangent to the line of action *c d* which intersects the line of centers at the pitch lines.

Imagine the circles *a b* to be cylinders and *c d* a portion of a string wrapped upon them. If one of the cylinders be made to wind up the string as it unwinds from the other, the two will have angular velocities dependent upon the two base cylinders *a b* which are proportional to the pitch circles. If now we follow any point *e* upon this string as it travels from *b* to *c* it will trace the two involutes *f g*, which, being traced by the common point, must at all times be tangent and may therefore be used as tooth outlines. The length beyond which these curves may not be used as tooth outlines without interference is found by striking a circle, as *h*, from either center through the point of tangency of the line of action with the opposite base circle.

If now the circle *B* be moved away with its center at *j*, the angle of obliquity will be changed, but the base circles being unaltered the velocity ratios will remain constant and any point *e* upon the line of contact will trace identical tangent involutes one of which will have been caused to slide along its mate *f* to a new position *k* as the gear moves to its new center *j*.

It will be seen by the preceding that the gears will change their angular relation also, which would cause trouble if the shafts were required to be exactly timed with each other at all center distances.

Combination Inventions.

Not long before General Nelson A. Miles's retirement from the United States Army, an inventor, with the assistance of sufficient credentials, obtained an interview with him in regard to a novel type of bayonet. The weapon, so its author claimed, could not only be used for lethal purposes, but, in addition, was an excellent trench digger, bucksaw, ax, and bowie knife.

General Miles heard his visitor patiently, and then said:

"Once upon a time an old farmer drove into town and called on a dentist. To the latter he made known the fact that he wanted a full set of teeth. 'And,' he added, 'make 'em so that they'll fit my wife's jaws as well as my own, for I want to use 'em by day to chew terbacker, and she wants 'em by night to chew sweet flag.'"

"Well, General?" queried the inventor.

"The point of the story," continued the veteran, in his blandest manner, "is that teeth, bayonets or men that are used for hybrid purposes are invariably failures. Every man and every invention has to be a specialist, so to speak, to be successful."
—*Success.*

A German View of the Premium Plan—I.*

BY B. SCHILLER.

The purpose of the present paper is to make a critical examination of the advantages and disadvantages of the various modifications of the original Halsey premium plan of rewarding labor.

The curves in Fig. 1 give a comparison of the Halsey system with the Rowan system and with piece-work and day-work prices. The vertical distances represent the labor cost of each article in cents, and the horizontal distances the time occupied in producing the article. The curves are drawn for a case where the piece-work rate is $3 per piece, the day rate 30 cents per hour, and the standard time per piece is ten hours for both the Halsey and the Rowan system. By the Halsey system the man is paid his hour rate for the time actually worked plus a fixed fraction (in the present case one-third) of the time saved from the standard time. In the Rowan system the man is paid for each piece his hour rate on the actual time increased by a fraction of the time saved. Here the fraction is not constant, as in the Halsey plan, but has for its numerator the time actually taken and for its denominator the standard time. Thus, while the time saved increases, the fraction of this time which is paid for grows smaller. The curves show this clearly.

Line 1—Day Rate.—At a fixed rate per hour of 30 cents the labor cost when one article is produced in ten hours is $3, and as the time of production is reduced the labor cost falls proportionately along the straight line 1.

Line 2—Piece Work.—The labor cost is independent of the time of production, being at the fixed rate of $3 per piece.

Line 3—Halsey System.—The labor cost per piece falls regularly with the time of production, but is always higher than at a day rate.†

Line 4—Rowan System.—The labor cost falls with reduced time of production, along a curve which goes down less rapidly than the Halsey line in the beginning and more rapidly later on.

If a vertical *B F* be drawn corresponding to the eight-hour time of production, *C D* is the additional cost or premium by the Halsey system over day work, and *C E* is the additional cost or premium by the Rowan system. *D E* is the difference between the two systems. It is seen that at first the Rowan premium is higher than the Halsey, but at 3⅓ hours is the same, and from there down is less than the Halsey premium. The Halsey premium increases steadily with reduced time of production. The Rowan premium increases until it reaches a maximum of five hours production time, and from there falls again to zero. That is to say, the maximum premium is earned when the work is done in half the standard time. In the Halsey system the premium increases constantly so long as the time of production is reduced, and for this reason the Rowan system has been held to be preferable, as there is less chance of overpayment in case the standard time is set too high. This is true, and particularly so when the standard time of production is maintained the same without reference to the man's day rate. It must, however, not be overlooked that the limit to the premium in the Rowan system occurs when the time of production is half of the standard time, and this limit, although never reached in practice, will have the same restricting effect as the fear of a cut in a straight piece-work system.

It will be seen that at first a reduction in the time of production gives a higher premium by the Rowan than by the Halsey system, but that after a certain point the Rowan premium is less than the Halsey. Now, experience teaches that it is the first acceleration of production which is most easily attained. In all shops which have changed from day to piece work it is seen that the production is considerably increased, the men turning out more work in the same time. But to obtain a further reduction in the time of production is much less easy. Time can be saved in three ways. First comes the industry of the man, less time will be lost in beginning and stopping work, and the man will not be so ready to leave his place. A further improvement can be made in the operation of the machine, the heaviest possible cuts being taken, etc. When all that is possible in these two lines has been accomplished, the only possibility of further reduction lies in the intelligence of the man using the machine.

Following these considerations, it appears that the premium for time saving should be least for the first saving, with an increase of premium as the greater difficulties are encountered. This is the case with the Halsey, but not with the Rowan system. A man who, for example, has improved on the standard time by 30 per cent. could perhaps increase this to a 50-per-cent. reduction, but will not do so because his share of the saving is too small. The Rowan system has the same restricting influence as the fear of a cut in a piece-work system.

*Abstract of a paper by Chief Engineer Schiller, of Vienna, published in the *Zeitschrift des Vereines Deutscher Ingenieure* for August 22, 1903. Translated by Lawford H. Fry.

†While the author's statements are true, they are apt to be misunderstood. Supposing a reduction of time to be made, the cost under the day-work plan would be less than under the premium plan, but under the day-work plan the reduction will not be made. The principle of the premium plan consists of offering a portion of the gain due to reduced time to the workman as an incentive. That is, of a theoretical gain due to day work, which is not realized in practice, the workman is offered a portion, in order that the employer may obtain the remainder.—F. A. H.

The Rowan system is offered to prevent too great a loss by a mistake in fixing the standard price. To weigh this advantage, attention must be given to the likelihood and effect of such a mistake. A purely clerical error need not be considered, as it can be corrected without exciting the mistrust of the men. And even if there is no special price-making department, the prices can be arranged between foremen and men without any fear of getting them several hundred per cent. too high; so that even if the time for the work were cut down 75 per cent., there would not be any very serious loss, and the cost of production would at any rate be lower than was counted on.

Usually in introducing a premium system the premium is set at 25 to 30 per cent., so that it is not necessary to be too exact as to the standard time allowed. If the standard time is arranged generously it has an excellent effect in winning the confidence of the men and exciting their industry.

If with the Halsey system the man sees that by considerable saving in the time for the job he can make a large increase in his earnings, he may be allowed to do so. He is at the same time effecting a large reduction in the cost of production. With reasonable care one can avoid errors which would give the man an undeserved or absurdly high rate of wages.

If commercial conditions reduce the price of the manufactures it is better to look for some other means of reducing the cost than to cut the price of the labor, and thus to shake the workman's confidence in the system and the treatment he is receiving.

If a time-saving device is introduced it is not always necessary, and is often entirely wrong, to reduce the standard time for the work.* For example, if a man is transferred to a new machine, he loses the skill he had acquired on the old one, and the reduction of the allowable time works him a double injury, while if the original time is left the advantages of the new system for both parties will be more rapidly developed. A reduction of the standard time reduces the incentive to increased activity.

To determine the proper procedure and to hold in all cases the scales even between employer and worker is a difficult problem, but one which the conscientious manager cannot avoid.

Another disadvantage of the Rowan system is that the calculation of the premium is too difficult. With the Halsey system even the workman who is not used to much calculation can determine in advance how much he will earn, as he knows just what premium he will receive for each hour gained.

Many men cannot follow the Rowan system, and on pay day must take the word of the paymaster as to what they are to receive, and, what is worse, they do not know in advance what premium they are to receive, and thus lose the greatest incentive to increased production.

The two systems considered above have the common failing of not taking sufficiently into account the day rate at which each man is classed. Take, for example, three men rated respectively 20, 30 and 40 cents an hour, working on a job for which ten hours are allowed, the premium being one-half the time saved. If each takes the full time the labor-costs are $2, $3 and $4. Now, if the 30-cent man does the job in five hours, he receives $2.25, reducing the labor-cost 75 cents and earning 45 cents an hour. The 40-cent man with the same time-saving of five hours earns 60 cents an hour, the labor-cost being $3. That is to say, the better and more highly paid man doing the job in the same time as the other, makes the labor-cost higher. In order to make the same saving to the employer he must save 8.75 hours on the job, which is a practical impossibility. His earnings would be at the rate of $1.80 an hour. Finally, if the man rated at 20 cents an hour does the job in five hours, the labor-cost is reduced to $1.50, and he earns 30 cents an hour.

Again comparing the time each must save so that they all earn 45 cents an hour, this will be: For the 20-cent man, 7.14 hours; for the 30-cent man, 5 hours; for the 40-cent man, 2 hours; the labor-costs being $1.28, $2.25 and $3.60. That is to say, the man with the lowest rate, who is presumably the most inexperienced workman, must do the work more quickly than the best man, and at the same time the employer gets the work at almost one-third the labor-cost.

Theoretically, the job, whoever does it, has the same value to the employer, and it is unfair to require that in order to earn the same rate of wages, the inexperienced man shall do more work in the same time than the man who is aided by his experience and knowledge.

The same defect is found in the Rowan system, and of both systems it may be said:

(1) The higher the day rate the greater must be the time saved to give the same labor-cost.

(2) The lower the day rate the lower the wage earned with the same time-saving.

(3) The lower the day rate the lower will be the labor-cost for the same time-saving.

Unless the time allowed on a job is varied to correspond to the day rate given the man, this works an injustice to the man which is not found in the old piece-work system.

In most shops the man's day rate does not depend solely on his ability. Where the piece-work system is not used it is usual to start a new man in at a certain locally determined minimum rate, which is gradually raised. Consequently, men who have held their positions for a number of years get more than will be paid to any new man, and it by no means follows that the senior man is more capable than the

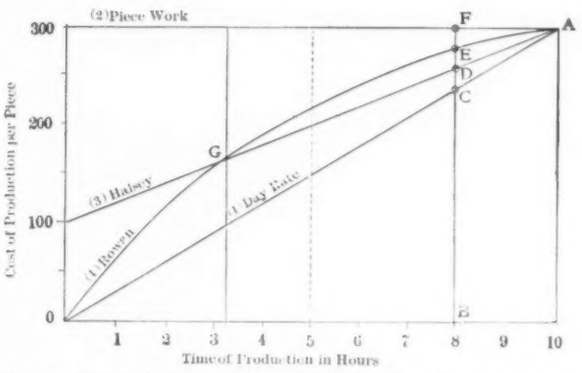


FIG. 1. RELATION BETWEEN COST AND TIME OF PRODUCTION BY VARIOUS SYSTEMS.

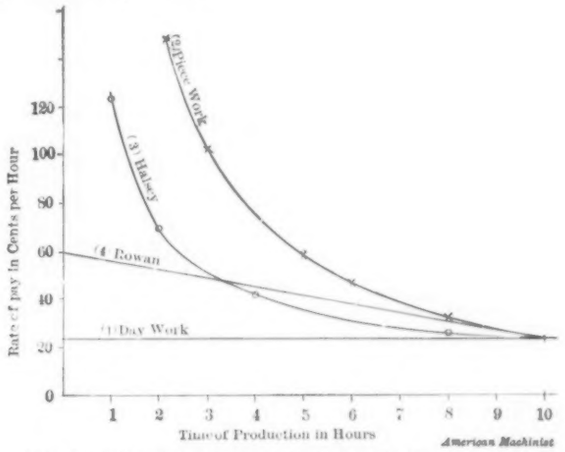


FIG. 2. RELATION BETWEEN HOURLY WAGE AND TIME OF PRODUCTION BY VARIOUS SYSTEMS.

*I cannot agree with this. The object of the premium plan is to give the workman an increase of pay due to his own efforts to increase production. To leave the standard time unchanged when new methods are introduced is to make him a present of part of the gain due to the new methods. One of the most serious objections to the Rowan plan, in my judgment, is that it does this very thing. —F. A. H.

newcomer.* It would lead too far to discuss all the points which influence the rating of the men—for example, the low wages paid to men on coming out of their apprenticeship, etc.

In modern practice, and particularly with machine work, it frequently occurs that the output of a man is independent of the time he has been employed. In this case it must be discouraging to a man, who for some cause has a low rate, to receive less for his work than another man does, although he produces it in the same time and equally well. In order to earn the same wages as the man with the higher rate it would be necessary to work harder—that is to say, show himself more capable. At the same time, though more capable, he has to work harder for his money, without there being any just cause for the difference.

Recognizing this defect, Isaac Ross, of Leicester, England, developed, in 1902, another system, in which the time allowed is not independent of the man's day rate, as in the Halsey and Rowan systems.

Mr. Ross fixes a maximum labor-cost or piece-work price for each job, and each man is given a certain day rate. If he does the work in such a time, that

$$\text{time} \times \text{rate} = \text{piece price}$$

he is paid for his time at the regular rate without premium. If he does the job in less than this time, he receives as premium half the difference between his wages for the time at the regular rate and the piece-work price. Obviously the time allowances for men with different day rates will be different for the same job. The highly rated man must do the work in less time than the low-rated man. When the work is done in less than the standard time, the man's earnings are increased and the labor-cost of each job is reduced.

Compare the cases of three men, rated respectively at 20, 30 and 40 cents an hour, working on a job for which the piece price is set at $3. To earn their normal rates, the first man will take 15 hours; the second, 10 hours, and the third, 7.5 hours.

Now, suppose each man does the job in half the time allowed. The first does the job in 7.5 hours, saving 7.5 hours. His premium is therefore:

$$\tfrac{1}{2}\ (300 - 7.5 \times 20)$$
$$= \tfrac{1}{2}\ (300 - 150)$$
$$= 75 \text{ cents}$$

The labor cost is therefore 7.5 hours at 20 cents plus 75 cents premium; that is to say, $2.25. The second man saving 5 hours, and the third man saving 3.75 hours, will both make the same reduction in cost; so that when each does the job in half his allowed time, the labor-cost is the same, viz.: $2.25 in all three cases—the working times being as follows: For the 20-cent man, 7.5 hours; for the 30-cent man, 5 hours; for the 40-cent man, 3.75 hours. That is to say, the less skillful workman with the lower day rate is allowed a longer time than the highly paid, skilled man without increasing the labor cost. Again, if we assume that all three men take 5 hours for the job, the results will be as follows:

Base Rate. Cents Per Hour.	Rate of Earnings. Cents Per Hour.	Labor Cost.
20	40	$2.00
30	45	2.25
40	50	2.25

The differences in the rates actually earned are not so great as in the other systems, and the percentage of increase is greatest for the man with the lowest base rate. This appears reasonable, as he, being the least capable, has to make the greatest exertions to do the work in the same time as the others.

If the three men are all to earn the same rate of 45 cents an hour, their times for the job must be: For a base rate of 20 cents, 4.28 hours; for a base rate of 30 cents, 5 hours; for a base rate of 40 cents, 6 hours. The labor costs would then be $1.93, $2.25 and $2.70 respectively.

(Concluded next week.)

*It must be understood that the author discusses here the custom which obtains in Germany. It is there, we understand, the usual custom to give all new employees a low and substantially uniform day rate and to increase this periodically as the length of service increases, and without much regard to the man's actual ability.—Ed.

Forging-Machine Dies.

BY THOMAS BEASLEY.

Working dies for forging machines should generally be cast basic steel, as this material is easily worked and can be depended upon to last. I prefer it to tool steel, as the latter often cracks and peels off with little use. Tool steel also often has hard spots almost impossible to machine. Cast iron is used quite extensively for these dies, and to illustrate the difference between the two metals for this purpose: one pair of cast-iron truss rod dies would last about three days and then had to be worked over, while the basic steel on the same work ran six months and was still in good conditon.

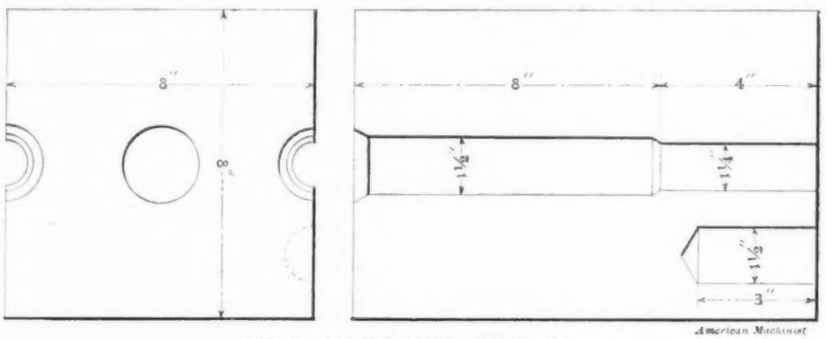


FIG. 1. DIE FOR ROUND UPSETTING.

Perhaps the simplest dies for these machines are the truss rod dies mentioned above. They should be planed in pairs and perfectly square. The dimensions of course vary, but 8x8x12 inches is very good and will generally meet all requirements, except in very long upsets, and in this case the dies should be as long as the machine will take. A hole should be cored through the center to pass a rod through to handle them with. The sketch, Fig. 1, gives the idea of the general dimensions for 1¼-inch rods upset to 1½ inches, as used in bridge and car work, the upset

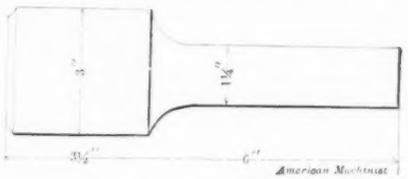


FIG. 2. ROUND PLUNGER.

being 6 inches long. A V to guide the drill should be planed in the center of each face before removal from the planer to serve as a guide for the point. In boring these dies sheet iron strips 1-32 inch thick are placed in the joint before the 1¼-inch hole is bored; this provides for the grip of the iron. The strips should be removed before counterboring for the upset,

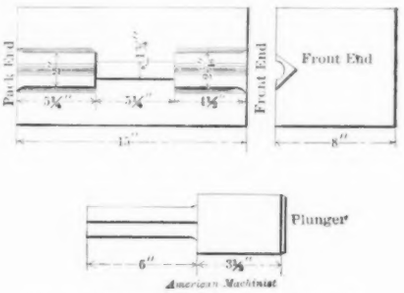


FIG. 4. UPSETTING ROUND TO SQUARE.

as, if this is overlooked, the upset will be oblong and shy of stock on two sides, and full on the top and bottom. It will be noticed that there is a 1½-inch counterbore 3 inches deep below the grip in the back portion of the die. This practically doubles the working life of the dies. The plunger in upsetting the iron wears the outer portion of the dies quite rapidly and the end of the rod is left too large. This causes trouble when the work goes to the threader, as the end won't enter the threading dies. The counterbore is to work this enlarged end down to the right size and answers the purpose nicely. It should be put in every pair of dies, as it

will save lots of time and trouble and perhaps some sulphurous epithets.

The header or plunger is made according to the form of the header block, but the most common form is like Fig. 2. The end is cupped to hold the iron in line when the plunger hits it. These dies are about the simplest form used on these machines, but of course the machining and fitting should be as accurately done as with the most complicated forms. The sharp corners should be filed off the grip end, but the upset end should be left as it is bored.

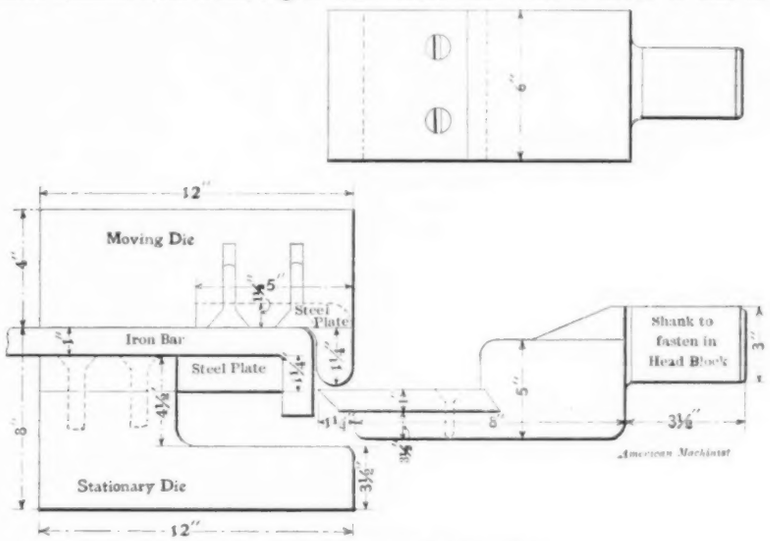


FIG. 3. BENDING AND SHEARING.

For gibbing iron on these machines the dies are more complicated, but ordinarily one pair of dies and the plunger will do for any size or width of iron if properly made. One plate will do for two lengths of gibs. The dies can be made of cast iron, the plunger of wrought iron and the plates of tool steel. Fig. 3 gives the dimensions and general outline. The gibbing plate on the moving die and the cutter plate on the stationary die are dovetailed to place and should be a tight fit, with 1-inch steel screws to hold them in place. The plate on the stationary side should be just long enough to allow the plunger to have a bearing against the side of the die just before the cutter does its work; if not, the plunger may break or bend, and it does a bad job of shearing. The shear blade on the plunger also should fit in a dovetail, as the screws holding it sometimes work loose and cause a wreck if this is not done. In drilling for the screw holes in this plate, care should be taken to have the screws draw the plate tight against the dovetail; this insures a good, tight job and is a safeguard against accident. These dies give a wide range of work, and the product is all that could be expected. The shear blade and the plate on the stationary die should be kept in good condition—that is, good and sharp—and the work will come from the dies in first-class condition.

With these dies it is not necessary that the gibbing plate should completely bend the iron to the right angle before the shear operates, but the point of the iron should pass the shearing point on the stationary plate at least ¼ inch, and then the shear will do the rest as it carries the hot iron up against the stationary plate to do the shearing off of the surplus stock.

It often occurs that round iron has to be upset to square a given portion of its length, and to make the corners fill out square and nice the dies have to be made to upset the iron at least 3-16 inch larger, and it is then worked down to the proper size in a different portion of the die. For illustration, if we had a bar of 1¾-inch round and one end was to be upset to 2 inches square and 5 inches long, it would be necessary to make the plunger 2 3-16 inches and the square portion in the dies a little larger. A squared portion the exact size next to the operator is made and ¼ inch longer than the finished iron and given plenty of clearance. The iron is worked back and forth after upsetting until it is the same size as the recess in the dies. I give a sketch of the dies and plunger, Fig. 4.

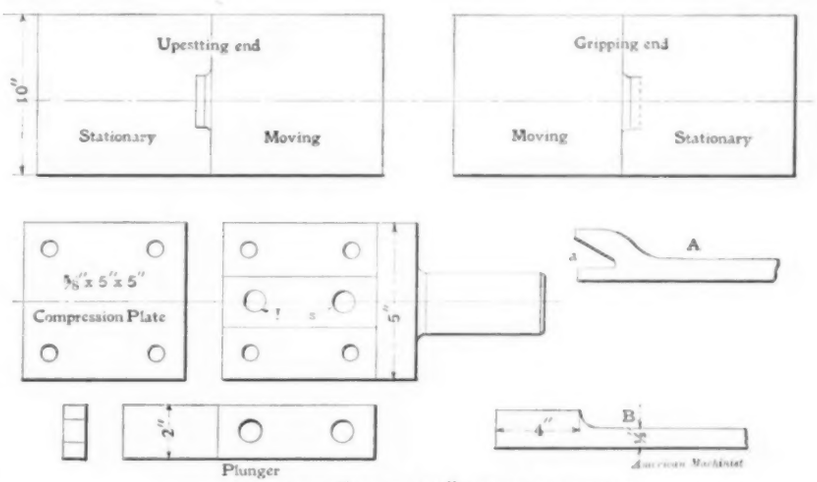


FIG. 5. DIE FOR "BACK RODS"—FIRST UPSETTING.

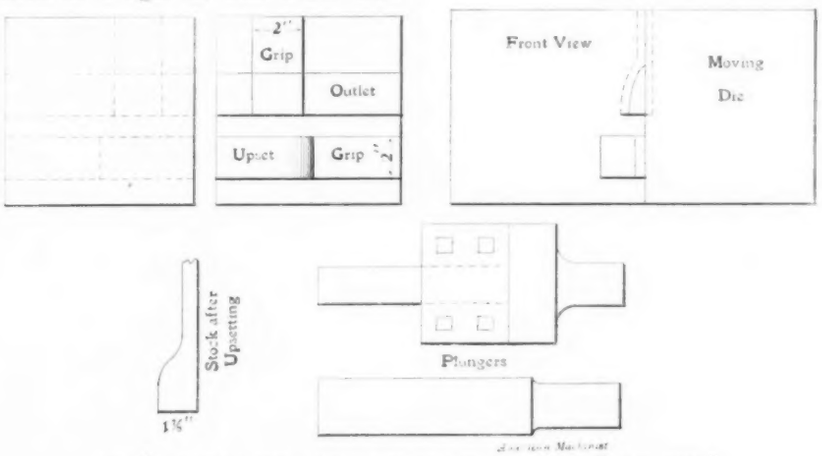


FIG. 6. DUPLEX DIES AND PLUNGERS FOR FINISHING "BACK RODS"

The center portion of the dies is the grip; this fact must be borne in mind when drilling them, and a 1-32 inch liner must be put between them before drilling. The plunger should work freely in the front end when the dies are clamped together, and the end of the plunger should be slightly cupped to hold the iron in line; also the front end of the dies should be flared or beveled out to receive the plunger. This is very important in machines that have the plunger mechanism worn, causing the plunger to wabble in action. The back end or corners on the dies should be chiseled off rounding, about ½ inch radius, so that the hot iron will

have some outlet in squeezing down to size. What little stock works into these recesses is squeezed back to place again on the next turning, and the stock eventually comes out of the dies smooth and the right size.

The designers of dies for these machines often make the mistake of supposing that iron will upset three or four times its own thickness at one operation. The rule is to upset to double the thickness at one operation and no more.

A die for "back rods" for switch work is given in Fig. 5, also one end *A* of a rod. This requires two sets of dies. The first operation consists in upsetting the piece from ½ inch to 1 inch thick and 4 inches long, as at *B*. The dies and plunger are simple, being recessed out to the size of the iron; that is, the stationary die is all that requires recessing, as the moving die is used simply as a grip. The plunger in this case is a special arrangement and answers for a variety of useful work.

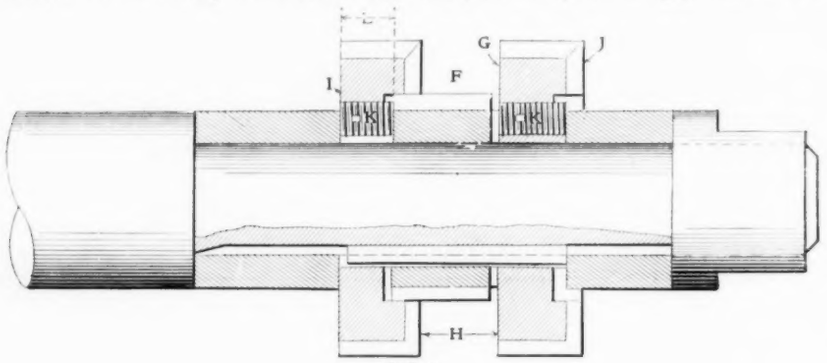


FIG. 2

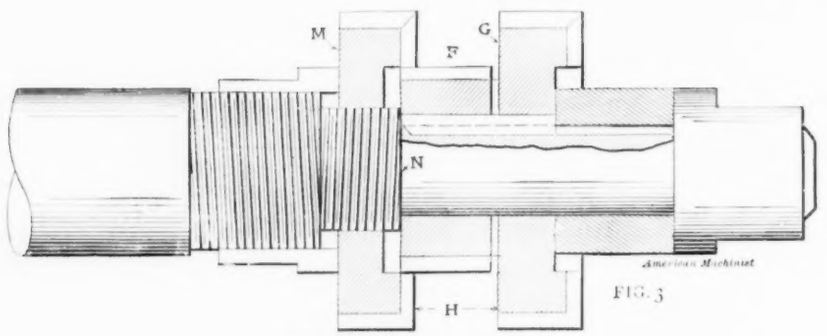


FIG. 3

TWO SETS OF STRADDLE MILLS.

The header block has four 5/8-inch holes in the corner to fasten the compression plate down tight on the plunger. The two ¾-inch holes in the center of the header block are for pins to pass through the plunger and keep it from pulling out on the back stroke. The grip should be about 1-32 inch and the recess for the original size of the iron should have 1-16 inch taper to let the iron release easily after upsetting.

The next step is to make the dies to upset the stock to the finished size and to punch out the slot for the flange of the rail. This makes two distinct operations. The dies used for the first operation can be machined on the reverse side for this work, and it is better in setting the dies, as one operation follows the other and the die simply has to be turned over and clamped up again. Fig. 6 shows dies and plungers and the blank before it is punched. The space from center to center of plunger and punch must be the same as from center to center of the upsetting and punching recesses in the dies, and the outlet for the plugs that are punched out should be 1-16 inch larger at the back of the die to ease the punch after its work is done. All forging machines that are made now have recesses in the header block for two punches, so I will not describe any form for this purpose, taking it for granted that the machine will be up to date.

Some Handy Tools and Appliances.

BY F. J. LE CARD.

Fig. 1 is a tool for setting work quickly in the milling machine vise, and is especially useful upon milling punches like the one shown in the sketch. The collet *A* is made to hold straight-shank tools, 5/8 or ¾ inch, with a taper pointed set-screw to enter holes in the shanks of tools. There may be two or three holes to allow the tools to be adjusted; and this arrangement is better than depending on a flattened side of the shank for the screw to bear against, as the cutter cannot push back. The shank *B* holds a straight-edge *C*, beveled down thin. After a cut has been taken to get a face line, say, like *D*, the cutter is removed and tool *B* put in the collet, the straight-edge *C* being set against the face *D* and locked with the binding screw. Then by holding the straight-edge close to the top of the work, any line, say *E*, can be set very quickly and accurately to the cutting line by bringing it to the straight-edge. This is much more practical and reliable than using a pointer from end to end of the line or cutting and trying.

Figs. 2 and 3 show two sets of milling cutters for straddling, surfacing and leaving a rib on the work. The teeth on *F* should be coarse, and the sides *G* of the cutters should have teeth. But the main feature is the provision for getting and keeping the correct space *H* in both sets of cutters. In Fig. 2 this is done in either cutter *I* or *J* individually by the adjusting screws *K*, there being three of these in each cutter. So *I* can be set for one width, and *J*, by being put in its place, for another.

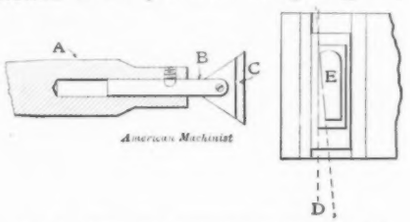


FIG. 1. TOOL FOR SETTING WORK IN THE MILLER.

The screws are set to the required position by measuring with a micrometer from the end of screw to the opposite face of cutter, as indicated at *L*.

In Fig. 3 the cutter *M* is adjusted by being rotated on the left-hand thread on the arbor, and is clamped by a right-hand nut threaded to a larger diameter on the arbor. This nut is flatted at opposite sides for a wrench. The other two cutters are keyed to the smaller part of the arbor and held to a shoulder *N*. The cutters in Fig. 2 are also keyed to take the strain from

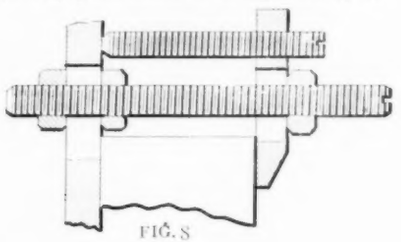


FIG. 8

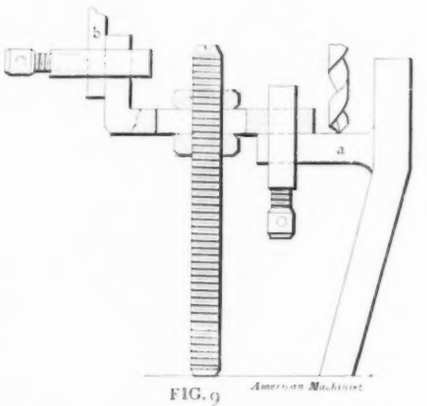


FIG. 9

HOLDING WORK IN THE LATHE AND DRILL PRESS.

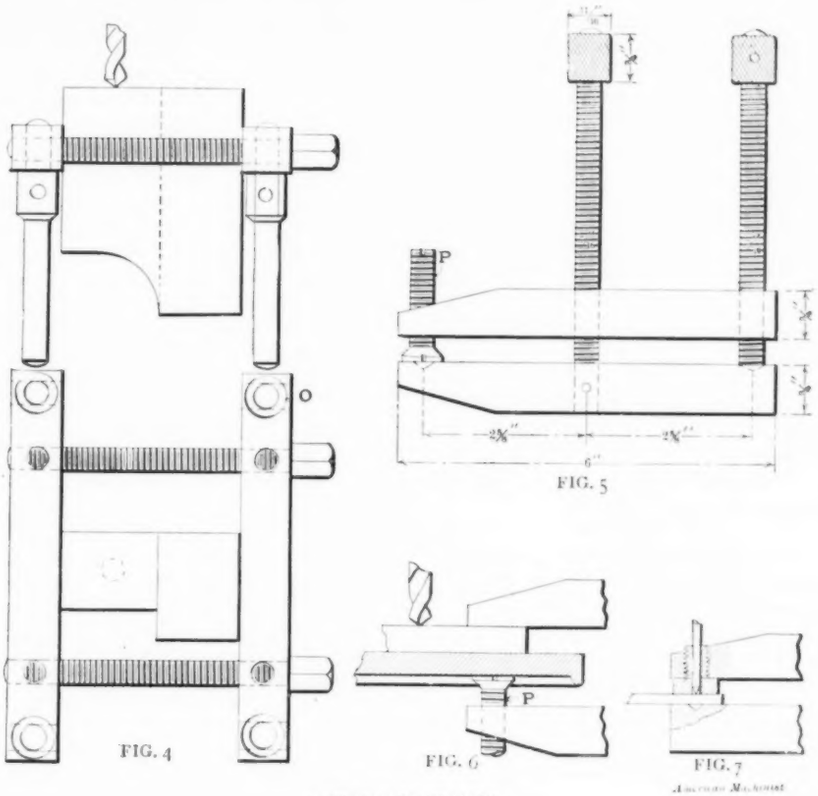


FIG. 4 FIG. 5 FIG. 6 FIG. 7

A COUPLE OF CLAMPS.

screws *K*. These adjustments allow one to grind the face mills and reset them easily with the micrometer, to compensate for the metal removed in grinding.

Fig. 4 shows a novelty in a clamp-dog. The stock required for the driving-pin, say at *O*, admits of the extending of the bars at each end without increasing the swing of the dog or clamp; so that while the clamping screws in the inner holes make the tool stiffer for round work, putting them in the holes farther apart gives the clamp more range for flat work. Then by means of supplementary feet fitting holes at right angles to the binding or clamping screws, a good drilling stand is formed. By using heavy stock, about ⅞, and screws and post holes not over 7-16 inch, the sixteen holes, as shown, can be made without weakening the bars. This stand is very convenient for holding punch shanks, etc., while drilling.

Figs. 5, 6 and 7 show, to my mind the best all-round clamp to be had of its style. The screws on opposite sides of the clamps are a barbarism. Make the clamp bars of ¾-inch, or better, ⅞- or 1-inch machinery steel, case-hardened after finishing. Make the distance from the central screw to the screw *P* and the rear screw equal; and get the holes for the screws in the center of the bars. Made in this way the lower arm can be swung round to furnish a flat base, if needed, as shown in Fig. 7. In this view a drill bushing and a locating point are shown as used for setting and clamping work to be drilled to a center punch mark. In Fig. 6 one advantage of the screw *P* is shown, where work is clamped to a small drill-press table having at its underside a ledge that would interfere with the ordinary clamp, unless a block were used below the platen.

In Fig. 8 is shown a stud with three nuts used in connection with a strap and jack-screw for holding work on the lathe face-plate or drill-press table. In Fig. 9 the stud with two nuts is used as a rest for an odd-shaped piece while drilling. The right-angle clamping piece is used in connection with a Besly clamp at *a* in a horizontal position, and at *b* in a vertical one.

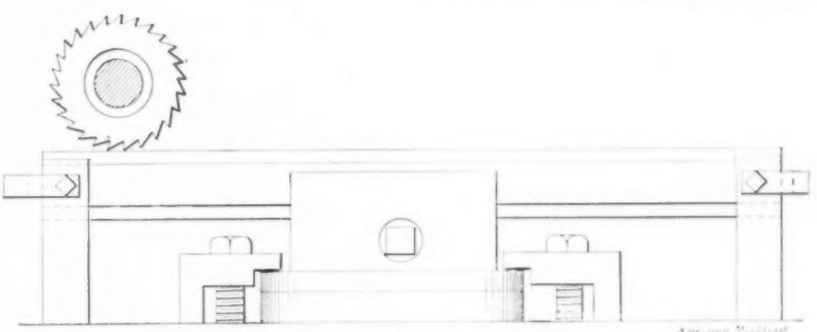


FIG. 10. MILLING A THIN METAL STRIP.

Fig. 10 shows a thin piece being milled on the edge. This is secured with Besly

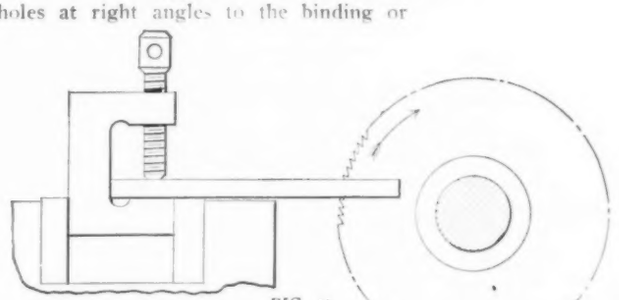


FIG. 11

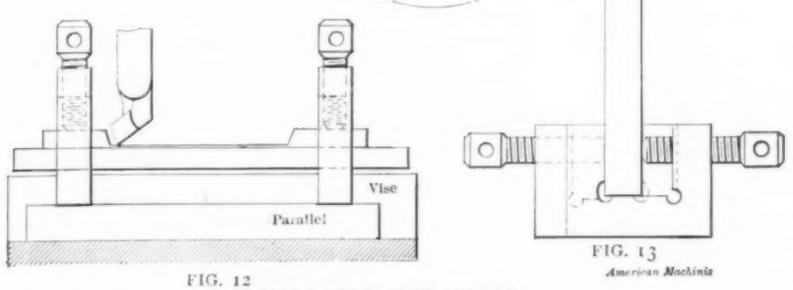


FIG. 12

HOLDING WORK WITH CLAMPS.

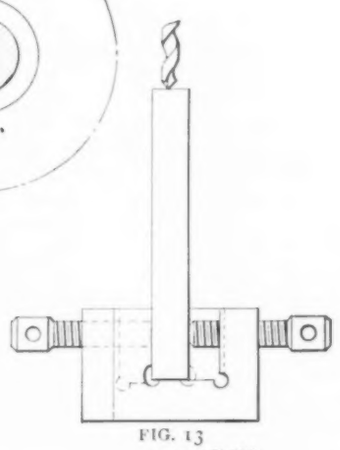


FIG. 13

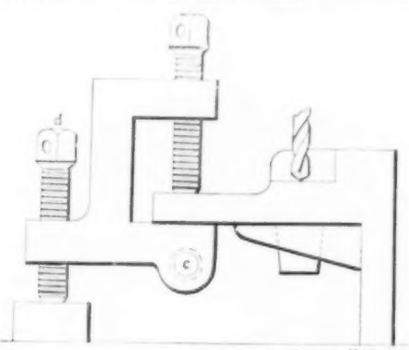


FIG. 14. A CLAMP AS AN OUTBOARD SUPPORT.

clamps at the ends to a thicker piece, and to two upright strips resting on the milling machine bed, the two long pieces being held at the middle in the vise. Figs. 11, 12 and 13 illustrate other ways of using the same clamps. In Fig. 11 a piece requiring slitting with a thin saw is held in clamps gripped in the vise, while in Fig. 12 a heavy cut is being taken on one piece clamped to another, and held by the clamps in the vise. In this way, as represented, the stock can be cut very thin.

Fig. 13 shows the method of holding a piece of work with two clamps in opposite positions, for drilling purposes.

Fig. 14 is a clamp in a class by itself, for supporting jig work, etc., while being drilled. The extra hole at *c* is for a different position for screw *d*.

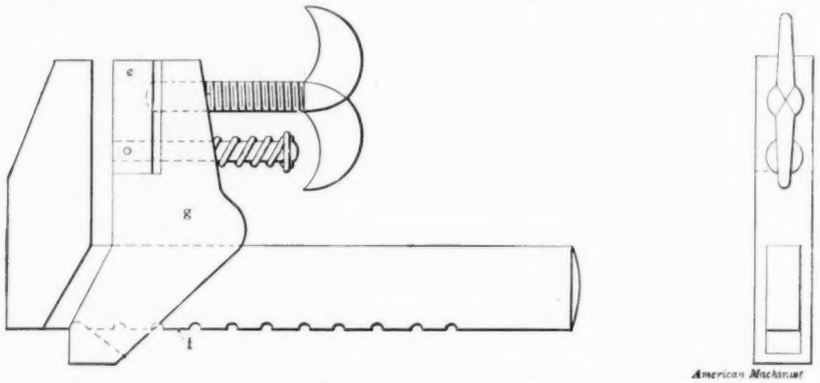


FIG. 15. CLAMP WITH ADJUSTABLE JAW.

Fig. 15 explains a very good clamp bor-rowed by all hands where it is owned. The adjustment of *e* covers one of the steps *f*; the piece *g* is tipped up as it is moved from step to step.

Factory Schemes—Three Special Lifts.

BY S. A. WORCESTER.

The economy and success attending the use of a special lift for binders suggested the use of specially designed lifts for other lines of work. The lift shown in Fig. 1 is for hoisting the cutter bar of the mower from near the assembling bench to a point near the painting tank on the second floor. The sliding crosshead, with its two-hook arms *C H*, has a long T-shaped shoe which slides in a guide formed by the two angles *L L* and the 4-inch face of the 4x8-inch wooden guide *C H G*. The hoisting mechanism is a worm and gear arrangement with an overhanging rope drum 18 inches in diameter, with the usual automatic brake and belt shifter operated by adjustable nuts on the drum shaft. The belt shifter is operated by hand by the pull *P*, the swinging dog *S D* or by either of the two treadles *T*, one of which rises when the other is depressed. The belts and brake are operated at the extremes of crosshead travel by the crosshead projection *S P* striking either the treadle *T* or the top stop *T S*. As fast as the cutter bars are assembled, they are pushed on to the two-pronged hooks *T H P*, which hang

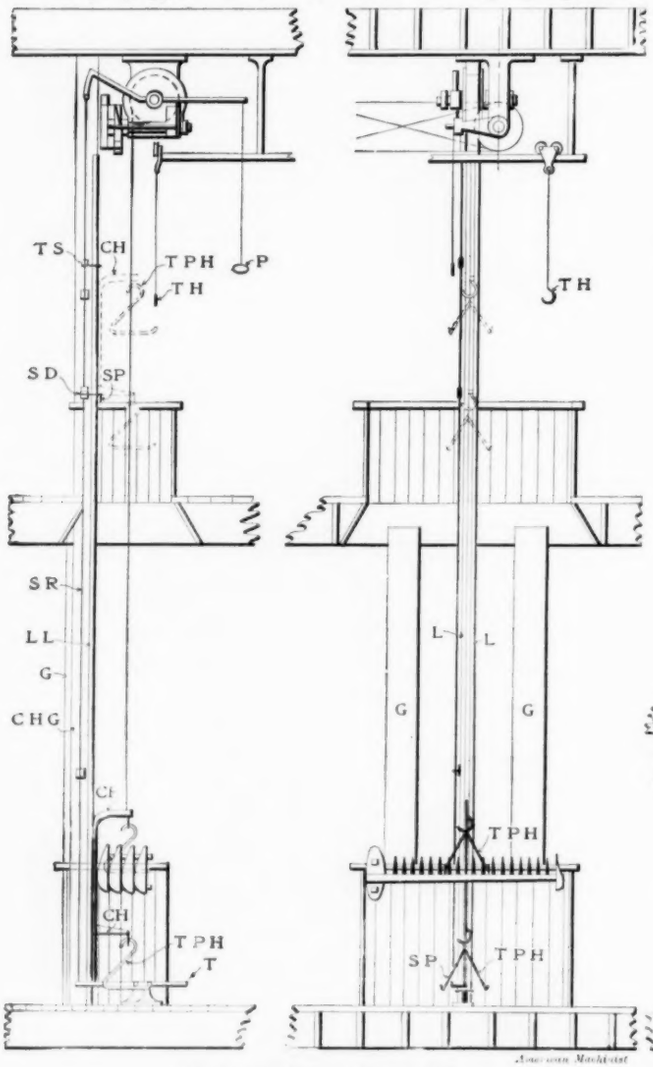


FIG. 1. SPECIAL FACTORY LIFT.

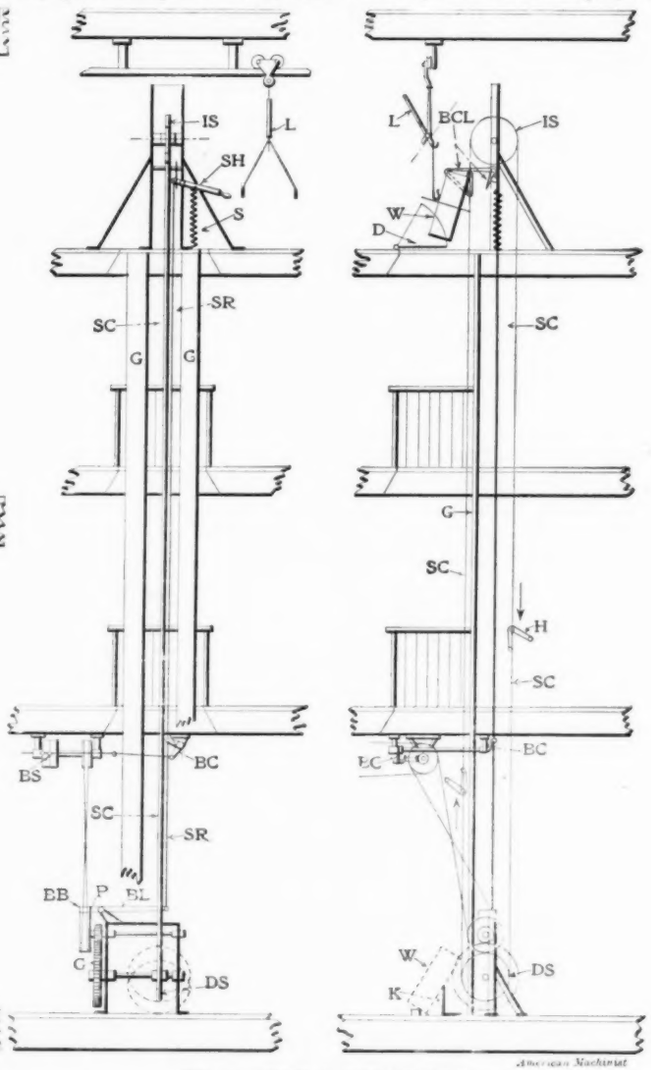


FIG. 2. SPECIAL FACTORY LIFT.

on the hooks of the crosshead. Four bars are shown on the upper hook. When the upper hook is loaded the workman presses the proper treadle and the crosshead ascends until the lower hook is at a convenient hight for loading, when he stops it by pressing the upper treadle until the lower one rising stops his foot at the horizontal position of the two treadles. He then loads the lower hook as fast as the bars are assembled, and when it is full he presses the proper treadle and sends the load up. The crosshead is stopped by the swinging dog *S D* at such a hight that the painter can swing the trolley hook *T H* into the hook *T P H*. He then, using the pull *P*, lowers the crosshead *C H* enough to leave the load hanging on the trolley, which he then pushes out of the way toward the painting tank. Then, by turning the dog *S D* out of the way and pushing *S R* down, the crosshead is hoisted until *S P* strikes the top stop, bringing the lower two-prong hook to the proper hight for transferring to another trolley which he has brought up. This load having been pushed out of the way, he hangs two empty two-prong hooks on the crosshead and sends it down for another load, turning the dog *S D* as soon as the crosshead has passed so as to stop the next load at the lower unhooking position. The guides *G G* prevent the bars from swaying to foul the hatchway. This lift travels slowly, about 25 feet per minute.

The wheel lift, Fig. 2, was designed for lifting the harvester main wheel, 32 inches in diameter and weighing about 150 pounds, from the assembling floor to the paint room. The endless sprocket chain *S C* running over the idle sprocket *I S* and the driving sprocket *D S*, is driven by the gears *G* and *P* in the direction of the arrows. The wheel *W* being laid on the knee *K*, as shown by dotted lines, and the machine set in motion, the hook *H*, which has two prongs spread about 5 inches, comes under the upper side of the wheel rim and takes the wheel up with it. On arriving at the stopping point the wheel *W* strikes the arm of the bell-crank latch *B C L*, lifting it and releasing the shifter handle *S H*, which is instantly drawn down by the spring *S*. This lifts the shifter rod *S R* which shifts the driving belt through its crank connection *B C* to the belt shifter *B S* and applies the brake shoe *B B* by its connection to the lever *B L*. The painter now swings the double trolley hook under two opposite spokes of the wheel *W*, and depressing the lever *L* and latching it raises the wheel clear of the lift hook and runs the trolley and wheel off toward the painting tank. He then raises the shifter handle *S H*, which is caught and held by the latch *B C L*. This releases the brake *B B* and throws the belt at *B S* on to the tight pulley, setting the chain in motion. The door *D*, which appears too wide to drop past the wheel *W*, has a large curve in the edge next to the wheel so as to leave some opening and allow the door to fall before the wheel has stopped. The guides *G G* prevent the wheel from swaying unduly. The countershaft could have been dispensed with and the tight and loose pulleys placed on the pinion shaft if the line shaft had been conveniently near, but such was not the case.

Fig. 3 is used for lifting three mower frames, on trolleys, from the assembling and testing floor to the painting floor. The decision to paint the mower one color and the wheels another by immersion, using two separate overhead trolley systems, one for wheels and one for frames, necessitated a general remodeling of the assembling, testing and painting floors of the mower department. The new features

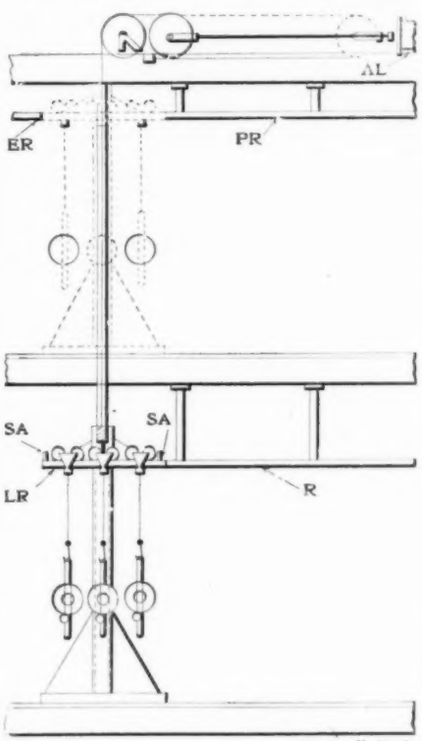


FIG. 3. SPECIAL AIR LIFT.

include new run-off or testing stands, belted and arranged to clutch the mower axle. The mower had originally been assembled and tested with its wheels on, using the driving belt on one of them. It occurred to me that the wheels and frame hung separately on trolleys would occupy less floor space and be much more easily handled than by trundling the frame around the floor with the wheels on. So with the new arrangement the wheels are not placed on the mowers until the last thing before taking them to the warehouse. Among the other new features were included *S S*, overhead automatic trolley switches, four dipping tanks with counterbalanced dipping arrangement shown at page 175 of the AMERICAN MACHINIST, the special lift, Fig. 3, here shown, and three special counterbalanced lowering devices for letting mowers from the trolley to the floor when packing for shipment. The mower frame with its gears is lifted from the assembling stand by a special lever trolley similar to that shown in Fig. 2 but having a hook of different shape. The frame is then run over to the "run-off" and tested. It is then taken on this lever trolley to a rail parallel with the rail *R*, Fig. 3, and about 5 inches away from it. On *R* hang the empty trolleys belonging to the painting system on the upper floor. The mower, weighing about 300 pounds, is then transferred by and from the lever trolley to the plain painting trolley, and as soon as three are thus transferred they are run on to the lift rail *L R*, as shown. A shifter rod, not shown, operates the valve of the air lift by suitable connections and has dogs which are struck by the cage at the top and bottom of its travel. The two safety arms *S A* are held over the rail by springs and prevent the trolleys from running off while the cage is in motion. They are thrown out of the way by a connection which strikes cams at the top and bottom of the cage's travel. A projection at each end of the lift rail *L R*, and behind it, enters a suitable socket on the back of the rails *R*, *P R* and *E R*, and brings the lift rail to exact alinement with the others. When the three mowers arrive at the top the painter runs them away on *P R* toward the painting tank and pushes three empty trolleys from *E R* on to the lift and sends it down for another load.

A Boy's Early Shop Experience.

The following was related at a recent meeting of the Western Railway Club by Mr. J. F. De Voy, M. E., of the Chicago, Milwaukee & St. Paul Railroad:

"I have been thankful in my personal experience that, when a boy of about sixteen years of age, I received a lesson from my employer that has never been forgotten. I was doing that in business hours which I should not have done, but he came to me in a kindly way and laid his hand on my shoulder, with the remark that that would not do in business hours, that I should do my work. The response came quickly that my work was done, and he said to me: 'Then help someone else do his work,' and the answer came quickly again, 'I cannot do that; I earn all I get.' In response to his inquiry as to what my wages were, I said, 'Two dollars a week, and I board myself.' His hand went back on my shoulder again in a kindly way, and he said, 'You are the best boy we ever had, I think, but just as long as you only try to earn just what you get, you never will get any more,' and I have been, oh, so thankful, and I am to-day, and I bear tribute to that man's memory for saying those things to me, and saying them kindly, because I went to work, and it was not very long after that that my wages were considerably increased. I did my part and he did his."

An Electric Grinder.

BY F. C. MASON.

In this article I will describe an electric grinding machine which I designed and built, which has been giving excellent satisfaction.

I wanted a strong, compact machine, which I obtained by the use of a modification of the old Siemens type of field. The ironclad type of field I will admit gives a more efficient machine with no external magnetism, but nevertheless the advantages of that type of field are few and its disadvantages are many, one of the chief disadvantages being the bulk of the field, which keeps the armature away from the work and necessitates the use of a larger wheel than necessary or the turning of the machine around at an angle great enough for the field to clear the work.

The general construction of this machine is simple, and I will not go into lengthy details, but rely chiefly on the drawing as being self-explanatory. The armature construction and winding will, however, need some explanation. The armature proper is built up of thin charcoal iron or electrical steel. Stock of about 24 gage will do nicely. If but one machine is to be built, it will not pay to make a die for a single armature. Therefore cut the stock into squares about 3⅝x 3⅝ inches, punching a ¾-inch shaft hole in the center, which should be a good, clean job. For armature heads use 3-16 inch boiler plate, the heads being 3⅝ inches in diameter, one being drilled and the other tapped with a ¾-inch hole, the latter having 20 threads per inch. Make a short mandrel like Fig. 4 and put on the boiler plate head with the drilled hole, then the disks and blanks, tighten up with the tapped boiler plate head and turn all down to 3½ inches diameter.

Next lay out the ⅜-inch holes for the winding slots by scribing a circle on each end, as it will be necessary to drill the holes from each end to bring them in perfect alinement. Finish by reaming, and, after reaming, mill ⅛-inch slots or openings from the periphery into each hole, to pass the wire through when winding. After milling remove the disks from the mandrel, clean thoroughly with gasoline and paint them with shellac or armature varnish before assembling. After assembling the disks on the shaft insulate each slot and the ends with hard fiber 1-64 thick, or, preferably, flexible micanite.

When the armature is wound complete, each slot will contain forty layers of No. 23 double-covered magnet wire. Cotton-covered will do, but silk-covered is preferable. Designate the slots by numbers from 1 to 20. Start in slot 1 and, leaving the starting end of the wire protruding about 4 inches, wind to the slot diametrically opposite (or slot 11), winding alternately on each side of the shaft for balance, as sketched in Fig. 5, until there are twenty layers—that is, ten on each side of the shaft. Bring the wire up to slot 2, make a loop about 3 inches long and twist it for a commutator lead. Next wind from slot 2 to slot 12 twenty layers. Bring the wire to slot 3 and make a commutator lead. Wind from slot 3 to slot 13 twenty layers. Repeat the operation from slot 4 to 14, 5 to 15, 6 to 16, 7 to 17, 8 to 18, 9 to 19, 10 to 20. This will give twenty layers in each slot with ten commutator leads extending all from one side, and the armature is exactly one-half wound.

Continuing, wind from slot 11 to slot 1 twenty layers, bringing the commutator lead to slot 11, slot 12 to 2, 13 to 13, 14 to 4, 15 to 5, 16 to 6, 17 to 7, 18 to 8, 19 to 9 and 20 to 10, bringing out a commutator lead each time and twisting the last wire to the starting end. This will give two distinct coils (or circuits) in each slot of twenty layers each and a double commutator lead from each slot.

There are other methods of winding, but I consider this one as the best. It is

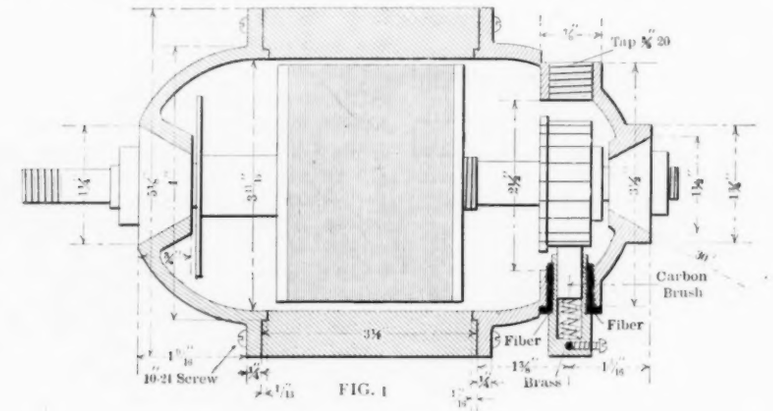


FIG. 1

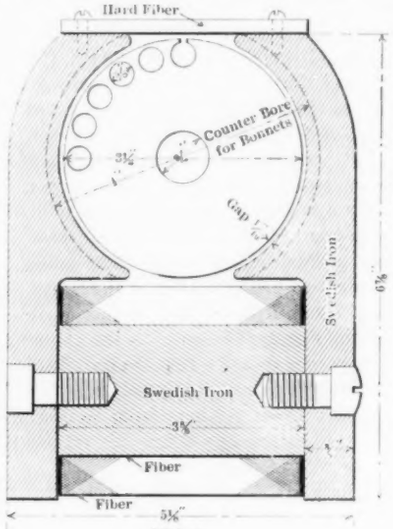


FIG. 3

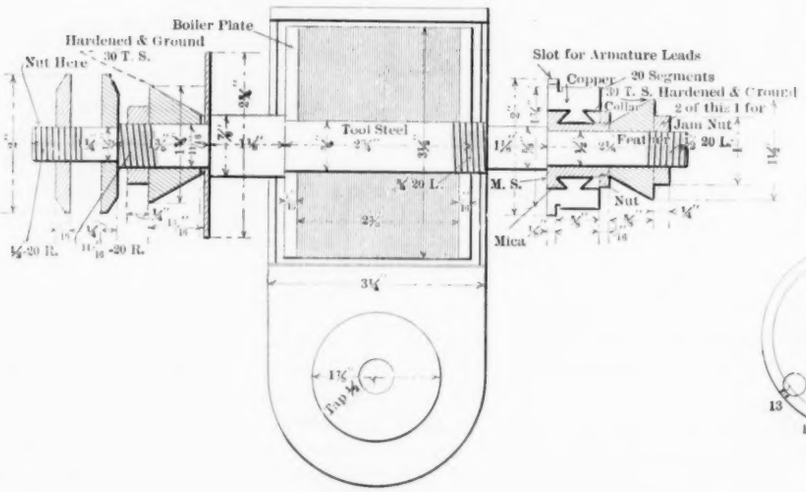


FIG. 2

A HOME-MADE MOTOR.

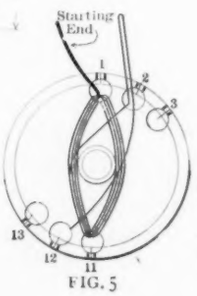


FIG. 5

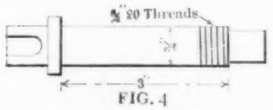


FIG. 4

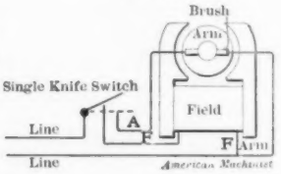


FIG. 6

not necessary to cut the wire from start to finish. The leads are connected to the commutator on the quarter—that is to say, instead of connecting them directly to the nearest segments, bend the leads around helically one-fourth turn and connect in rotation by soldering. It does not make any difference whether you lead to the right or left.

The field coil is wound with No. 29 double-covered magnet wire. Make a spool of hard fiber to wind on and wind in the lathe, evenly so as to get as much wire in the given space as possible. The starting and finishing end of this coil should be soldered to a piece of lamp cord for leaders to connect up by; about 12 inches long will do.

After finishing the winding, put on a layer of 1-16 cotton cord on the outside for a protection to your winding. Shellac this.

Fig. 6 shows a diagram of the connections for the finished machine to provide for starting it, which avoids the rheostat or starting box. With the single knife switch the field is cut in first, and the armature lastly when the knife is clear down, as per dotted lines in Fig. 6.

This machine does not have an independent slide movement, but is used in connection with a compound rest for angular grinding. For fastening to the rest I used a small angle-plate fastened to the field and slotted so as to be adjustable for hight, and a bolt to go into the T-slot of the compound rest. I put the motor shaft on the lathe centers, loosen the angle-plate and let it drop to place on the compound rest and tighten up. This leaves the motor shaft exactly the right hight and parallel with the lathe centers. The motor shown runs 4,000 revolutions per minute and will develop fully ¾ horsepower. It also makes a very substantial and handy bench grinder when not in use for circular grinding.

[This motor is not, of course, offered as a specimen of high-grade design nor as a machine of high efficiency, but as a satisfactory working machine that can be made by the user.—Ed.]

Automobile Construction—VII.

BY HUGH DOLNAR.

The crankshaft must be an elaborate and well-finished construction in even the very simplest form of explosion-motor driven vehicles. With the single-cylinder engine there is one crank wrist, with the shaft extending on one side for a journal and to carry the valve-action gear and water-circulating pump. On the other side the shaft must be quite long, to give space for two journals and the speed-change gear.

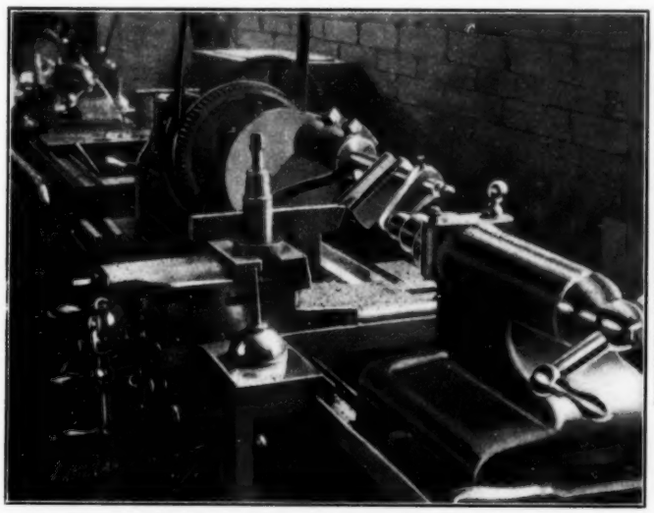


FIG. 19. OLDSMOBILE CRANKSHAFT WRIST TURNING.

The crankshafts are first roughed out in the lathe to fit the fixtures shown in Fig. 19. This is an ordinary lathe operation on centers, and is not illustrated. The flat edges of the crank arms are finished by either milling or planing. Fig. 19 shows the operation of finishing the crank-wrist, the special fixtures being a heavy plate screwed to the lathe spindle nose, and a centered arm, the hub of which is fastened to the short end of the shaft with quartering set-screws, the arm center taking the tail-spindle lathe center, which is in this case, I believe, not a pointed center, but a cylindrical end fitting a hole in the steadying arm, so that no end pressure is put on the shaft. It will be observed that the heavy hub on the face-plate is not counterbalanced. It will be noticed that this fixture hub is cut with three cuts, and the shaft is pinched with two heavy screws.

It may be worth while to give a little space to a good form of construction, as shown in Fig. 20.

In general terms the most desirable form for a lathe fixture is cylindrical, so that it may be finished smooth enough to wipe up readily, and will not cut off fingers or oil-can spouts or break files as it runs.

The cap is made separate from the body and closed down on the work with four pinching bolts, all as shown in Fig. 20, and about each bolt is a short-coiled spring so as to lift the loose cap as the bolts are slacked off. The pinching bolts are better with square heads than with hexagons, and a socket wrench is better than an open-end wrench to turn them with. It is also important to have work as nearly balanced as may be in the lathe, and as much of the balance weight as is desired may be cast in the chuck body, and the thin pieces *A B C D E*, rough castings, with the screw hole cast in them, can be added until the balance is as good as it can be made. This chuck is smooth and round, is very stiff, holds the shaft in the best possible manner, and gives opportunity for as good balancing as is possible.

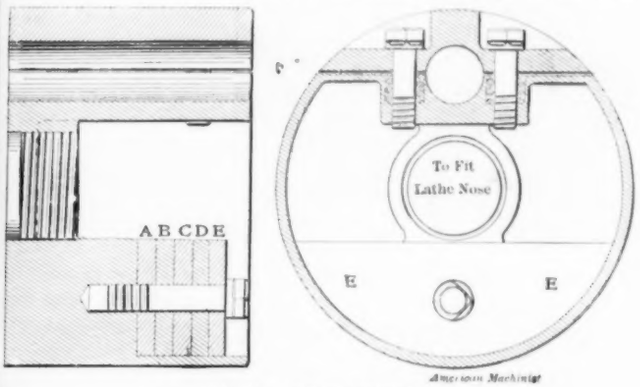


FIG. 20. SPLIT CHUCK.

Finishing the wrist may throw the crankshaft out of true more or less, and the final finishing of the crankshaft to its several diameters is done after the wrist has been turned, by clamping a single heavy U-shaped clip, pinched by a single large screw on the crank flats, as clearly shown in Fig. 21. This big clip is heavy enough to balance the wrist and the crank arms, serves to hold the crankshaft very firmly while sizing the ends, gives a crank balance, and is a very handy, simple thing, reliable and effective. I saw no heating of crankshafts on the testing stands to indicate that these slender little crankshafts were not as perfectly in line as need be.

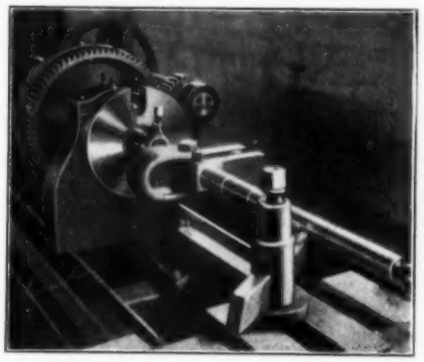


FIG. 21. FINISHING CUTS ON OLDSMOBILE CRANKSHAFTS.

The Oldsmobile crankshaft is completed by the addition of two heavy balance bobs, which are notched to fit the crank arms, and each secured with a single screw, as

shown in Fig. 22. The weight of the crank balances was of course ascertained by trial, and is very accurately applied, so that the motors run all alike, with almost no vibration at all. The flywheel is very heavy, as the motor drives the shaft only one-quarter of the time, and the wagon and motor must be driven by the

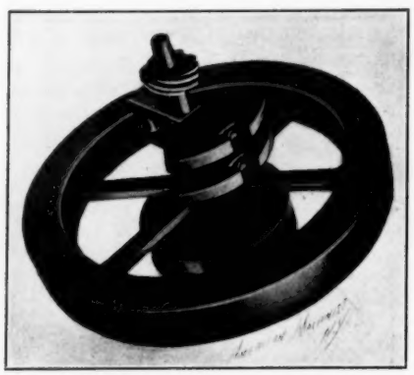


FIG. 22. OLDSMOBILE CRANKSHAFT, ASSEMBLED.

flywheel the other three-quarters of the time.

Having the completely assembled crankshaft, and the finished and babbitted cylinders and crank boxes, the motors are very rapidly assembled on wooden frames, seen at the left in Fig. 23, scattered about the floor. The rough "horses" serve merely to hold the cylinder upright while the crankshaft and flywheel are put in place in the crank-box journals, thus fitting the motor to be located on its own frame, where it is supported on three pads, one under the cylinder, carried on the cross-member of the angle frame, flange inside; one under the front part of the crank box at its extreme end, these two forming the principal supports for the engine, which is set on the frame by measurement, not on finished surfaces, and not touching the frame, but blocked up in correct location in reference to the frame outlines, with space enough between the bearing pads of the engine and the inside horizontal frame flange to permit the vacancy to be filled with fusible metal. The engines are very quickly placed, the spots where the soft metal is to be poured are surrounded by dams of plastic material. The pads, front and rear, on the cylinder and crank box are quite large in area, and as the filling metal used is undoubtedly of that easily fused composition which expands in cooling, the seating of the engine on the ¼-inch thick steel frames gives the very best support which could be obtained by any method whatever, as will be made evident by a very brief recital of the conditions. The motor and its crank case, coming together on finished surfaces of considerable extent, form a very rigid and substantial structure when they are bolted together, and take the crankshaft with no distortion, in the jig-babbitted shaft bearings.

The flat angle-steel frame, a mere unbraced rectangle, is very strong, but has no vertical stiffness to rely upon, and has no metal to spare for finishing cuts, as it is uniformly ¼ inch thick. Of course the frame could be pulled up to the cylinder pads with the bolts very easily, but this would set up strains which could not fail to be hurtful at some time in some way.

Instead of this forcing, the frame lies perfectly free on the erecting stand, and the motor is supported, also perfectly free—say ¼ inch, or less, free of the frame—and correctly located with the frame, then the dams are placed about the pads and the seats are poured with the expanding metal, which gives a perfect fitting between the motor and the frame at an extremely small labor cost. The holding bolts are in place when the seats are poured, and as the metal cools instantly, and the job is completed by merely screwing the holding bolt nuts down hard, the job is done in next to no time at all, so far as the relative locating goes.

There is some hand fitting done afterward in placing the cylinder head, tanks, change gear, and so on. The out-board crankshaft bearing pedestal is also supported on a soft metal pad, same as are the tank-stand feet. Thus the melting-ladle and a little fluid metal do the fitting of the engine and all its parts to the frame, and effect a perfect union between a heavy, rigid piece and a large, flexible piece with no strains and no distortions, in the most perfect manner and at very low cost.

The Oldsmobile motor frames simply lie on top of the erecting stands, and as soon as a motor is completely assembled it is put down on the floor and run out towards the testing room, the motors being trundled along like wheelbarrows on their own flywheels.

There are about forty stands in the testing room, which has a cement floor, with good drainage, and has three or four men, who keep the stands pretty well filled with motors, making a very noisy place of this department.

At one side of the testing room are two stands, where all of the motors are run for some time with the cylinder oil cups in place, and a stream of water from the force pump at the left rear delivered from the hose, seen supported above the cylinder in Fig. 24, flowing into the water-jacket opening on top of the cylinder, which has a handful of waste laid around it to keep the water from spattering. The motors are belt driven on these two stands, and the pistons are run in the water and oil bath, which flows down into the large pan below, and is pumped over and over again by the belted force pump. The surface of this water and oil has a thin scum of what looks like plumbago or stove polish floating on top of it, and the result of this operation, which is not very long continued, is to polish the cylinder bore and piston rings very nicely indeed.

Fig. 25 shows one side of the testing room, about which a book might be written, as here the whole engine is thoroughly tested; which means that every part is made to do its duty perfectly before the motor is passed over to the wagon assemblers.

FIG. 23. PART OF ROW OF ASSEMBLING STANDS FOR OLDSMOBILES. JUNE, 1903.

Some of the motors started at the first attempt, to my untrained eye, seemed exactly right in every way from the start, and were hardly touched at all, simply ran through their test, and were passed along to the wagon assemblers. Others

had a good lot of things done to them before they showed right. Of course, more gaging would have made more uniformity; whether the grand total would show better at less cost or no better at more cost, could only be determined by a very large outlay of money and a very long trial in actual work. I can say nothing about it.

Ten years from now it will be a great deal easier to tell what the really best way to build automobiles is. One thing is pretty certain; there is an unlimited demand for cheap, good motor wagons that will do their work as well as the Oldsmobile does on the road.

Laboratory vs. Shop.

BY CHAS. B. MAGRUDER.

The article by R. H. Smith at page 74 on this subject was interesting to all connected with mechanical education. Whether the laboratory or shop method is best deperds upon the object of the instruction and the character of the students.

For technical students who have but a limited time to devote to the study of machine-shop operations the rapid, systematic and progressive method pursued at the institutes of technology is perhaps the best. More principles can be worked into a course of this character in a given time than by the shop method.

For the trade school a combination of the two methods of instruction would be more beneficial to the student. Let him be put into the shop or laboratory and be given a course of exercises to bring out the fundamental principles of machine work and then, having acquired a certain degree of skill, he will be prepared for the more complex problems of machine construction.

For manual training students cut the course to suit the student. Where a boy is taking the course for its educational value and not for practical purposes, careful combination of the two methods is advisable. Where a student intends to pursue the work further in the shops or in a technical school, his course should be somewhat different.

Students such as Mr. Smith has are the pick of the secondary schools. By the time they get to the machine laboratory the men who have entered the institute to have a good time and for purposes other than work, have been weeded out. They have reached a certain degree of maturity; their minds have been trained from childhood and are in the best possible condition to receive instruction, and they have also an added spur, due to the fact that their degree depends upon a mark from this course as well as from their other studies. That the laboratory course arouses enthusiasm with men who are in for business is not surprising. It is a quick means to an end. They get a great number of principles in an amazingly short space of time under an enthusiastic instructor and their heads swell proportionately. They feel when they get through that course that they know just about the whole machine business, but, as very few of them go into the shop directly to have the idea abruptly knocked out of them, and as the gradual decrease in the size of hat that comes from office work is not very perceptible, no great harm is done. The course is designed to teach the fundamental processes of machine work, and does it well. The engineer can learn shop methods from observation of the application of those principles.

The students of trade schools have a great deal more time to devote to trade work. Taking the Williamson School as a fair example, the boys are not of the same mental caliber as those of the institute of technology. Many of them have been at work for several years and have had, in some cases, no more than grammar school work. They are of about the same age as the boys at the institute of technology, but have not had the advantages of years of systematic training. They are in school for the most part to learn a trade because they want to, or, in some cases, because their parents or guardians desire it.

For these students a combination of the two courses in the proper proportion would be advisable. Most of these students are earnest and ambitious, and, like those in the institute of technology, want the quickest possible way of acquiring the necessary knowledge. For these boys a course of exercises giving the fundamental processes, confined as far as possible to the most practical examples of the ideas involved, should be used. By careful selection, parts of machines in actual use by the student can be made to give the elementary processes in exactly the same order as the laboratory course. Any mechanic can call up a host of good examples of straight and taper turning, fitting, thread cutting, boring, milling, grinding and planing which the student can see in use about him. It is easier to think of examples than to get them systematically graded, but the latter can be done. After the boy has gone through this by class instruction, let the application of the principles be made to different complex parts of machines, and finally to a complete machine. A systematic course in toolmaking can be carried on with the other work, and many principles of general machine and tool construction be taught to advantage.

The students of this class are rather harder to interest than those of the institute of technology and require harder work on the part of the instructor. Problems of discipline arise which the college instructor would never be required to meet, and on the proper solution of which depends, in a great measure, the success of the instruction.

The students of the manual training

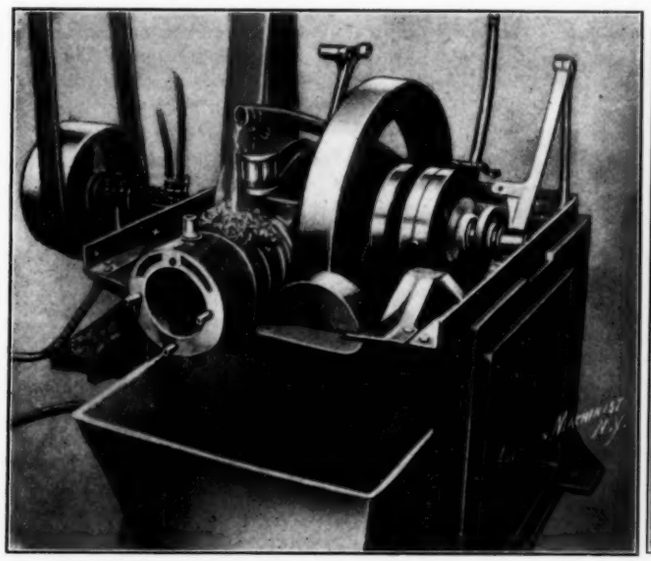


FIG. 24. OLDSMOBILE "RUNNING STANDS."

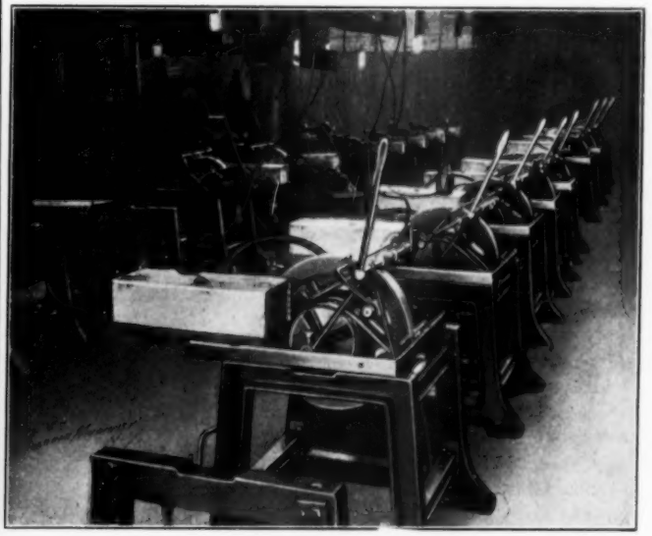


FIG. 25. ONE SIDE OF OLDS TESTING ROOM. JUNE, 1903.

school are younger than either of the foregoing and have to be handled very differently. Some are there to learn, and others are in the course and cannot get out of it. With this class of students discipline is one of the most important considerations. A course has to be devised that will keep all interested and employed. There are many among these pupils who have neither ability nor inclination toward mechanical work, and they furnish the hardest problems to deal with. To give this sort of pupil much work by the laboratory method, leading to nothing to show for his work except his own skill, means disciplinary trouble for the teacher. The boy must be given something that will keep him busy and interested, and here is where the mechanical toy or small machine or piece of furniture has its place. With careful selection and design, enough mechanical principles can be brought in to make it worth while. All teachers know that one or two pupils in a class who have no interest in their work can make it very disagreeable for all concerned. It would take an exceptional teacher to hold such a class with the laboratory methods exclusively.

The most enthusiastic supporter of the laboratory method of instruction would be apt to modify his views if he were to take charge of a manual training class with several minds bent upon mischief and rebelling against the requirements of the course. I question whether the author of "Laboratory vs. Shop" would retain his views after a few years with manual training school boys.

My opinions are not wild guesses, but are based upon three years' work at the Williamson School, a special course in laboratory instruction at an institute of technology under the author of the above mentioned article, one year as a teacher of manual training at the McDonogh School, Maryland, and four years as a machinist and toolmaker. I can be found, if you look in the right toolroom, at my lathe fifty-five hours each week.

The question of mechanical instruction is such a wide one and the conditions are so varied, that iron-clad courses are not advisable, and every teacher has to work out his own course to suit the conditions.

Compressed Air Drives a Steam Fire Engine.

Norwich, Conn., is the one city in the United States which has a Compressed Air Power Company. The air is compressed by power derived from the Shetucket River four miles from the city, a pressure of 90 pounds being maintained in the mains. The chief of the fire department of the city recently connected one of the steam fire engines to the air supply and ran it very satisfactorily for more than an hour. As an addition to the fire apparatus of the city, it is proposed to mount one or more steam pumps upon wagons and to hold them for emergent use to be driven by compressed air. In the trials with the steam fire engine, although the exhaust pipes were soon thickly coated with ice, there was apparently no internal choking to interfere with the running of the engines.

A Graphic Solution of the Open-Belt Cone-Pulley Problem.

BY LUCIEN E. PICOLET.

The analytic relations of the diameters of cone-pulley steps for open belts have been very amply treated in these columns, and it is not the purpose of the writer to review the analytical side of the subject further than to properly present the graphical solution in hand. This is a modification of one published about twenty years ago* and, although of greater merit than similar devices of more recent date, is now apparently forgotten. The solutions given heretofore, both graphic and analytic, disregard the belt thickness leading to a very appreciable divergence from the predetermined velocity ratios, while the one given herewith is readily adapted to include this factor without added complication, giving results exact within the limits of error of the formula it represents and of graphic analysis.

This formula, due to Rankine, is an approximate one, but has been shown to be sufficiently accurate for all purposes of practice and may be derived as follows:

Referring to Fig. 1,

c = distance between centers of driving and driven cone;

D and d = the given diameters of opposite steps;

x and y = the diameters of any two other opposite steps;

ϕ = the angle, in circular measure, made by the belt with center line;

L = the total length of belt.

Then for constant length of belt

$$L = \left(\frac{\pi}{2} - \phi\right) d + \left(\frac{\pi}{2} + \phi\right) D + 2c \cos.\ \phi \qquad (1)$$

$$L = \frac{\pi}{2}(D + d) + \phi(D - d) + 2c \cos.\ \phi \qquad (2)$$

*By H. W. Spangler, U. S. N., in Journal of the Franklin Institute, February, 1883.

Usually ϕ is small and the error is small in taking $\phi = \sin \phi = \frac{D-d}{2c}$ (3)

Also $\cos. \phi = \sqrt{1 - \sin.^2 \phi} = 1 - \frac{\sin.^2 \phi}{2}$

nearly and $\cos. \phi = 1 - \frac{(D-d)^2}{8c^2}$ (4)

Inserting the values of (3) and (4) in (2) and reducing:

$$L = \frac{\pi}{2}(D + d) + 2c\left(1 + \frac{(D-d)^2}{8c^2}\right) \qquad (5)$$

As the belt length must be constant for all diameters

$$L = \frac{\pi}{2}(D + d) + 2c\left(1 + \frac{(D-d)^2}{8c^2}\right) = \frac{\pi}{2}(x + y) + 2c\left(1 + \frac{(x-y)^2}{8c^2}\right) \qquad (6)$$

And finally we have:

$$\frac{(x-y)^2 - (D-d)^2}{2\pi c} + x + y - (D + d) = 0 \qquad (7)$$

If, for a given value of c the variable values of x and y be plotted about the co-ordinate axes $x\,x$ and $y\,y$ in Fig. 2, the resulting curve $o\,l$ is a common parabola. This follows from the condition that an equation of the second degree between two variables represents a parabola when the terms containing the second powers of the variables form a perfect square, which is the case in (7). It only remains to find the co-ordinates of the vertex and the direction of the principal axis to transform (7) into an equation of the form $y^2 = mx$, which is very easily constructed. Solving (7) for y and making $2\pi c = k$ for convenience in writing, we have:

$$y = \frac{2x - k \pm \sqrt{(k-2x)^2 - 4(x^2 + kx - k(D+d) - (D-d)^2}}{2} \qquad (8)$$

From which it is evident that the bisector of all chords parallel to the y axis is the line $y = x - \frac{k}{2}$ at 45 degrees with the co-ordinate axis and having for its y intercept $\frac{k}{2}$. The principal axis which must be parallel to this is, then, a line at 45 degrees passing through the vertex. At that point a tangent to the curve is perpendicular to the axis and has therefore a slope of -1.

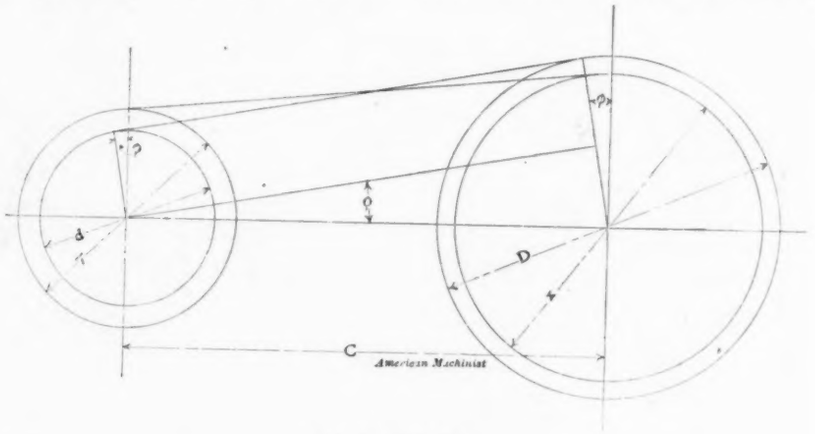


FIG. 1. NOTATION.

The slope equation of (7) is:

$$\frac{dy}{dx} = -\frac{\frac{du}{dx}}{\frac{du}{dy}} = -\frac{2x - 2y + k}{2y - 2x + k} \qquad (9)$$

At the vertex this is -1, and making $\frac{dy}{dx} = -1$ in (9) we have

$$x = y$$

and the axis is a line $x^1 x^1$, at 45 degrees with $x\,x$, passing through the origin as in Fig. 2.

Making $x = y$ in (7) the co-ordinates of the vertex are:

$$x = y = \frac{D+d}{2} + \frac{(D-d)^2}{4\pi c} \qquad (10)$$

To transform (7) to an equation about $x^1 x^1$ and tangent at the vertex $y^1 y^1$ we substitute for x and y:

$$y = \frac{x^1 + y^1}{\sqrt{2}} + \frac{D+d}{2} + \frac{(D-d)^2}{4\pi c}$$

$$x = \frac{x^1 - y^1}{\sqrt{2}} + \frac{D+d}{2} + \frac{(D-d)^2}{4\pi c} \qquad (11)$$

Inserting these values in (7) we have after reducing:

$$y^1 2 = -\sqrt{2}\,\pi c x^1 \qquad (12)$$

It will be noticed that (12) is independent of the given diameters D and d, and therefore the center distance c, only, determines the parabola $o\,l$. The values of D and d, however, determine the position of the origin m on $x^1 x^1$, for they constitute a pair of co-ordinates of the curve $o\,l$ about the axes $x\,x$ and $y\,y$ at 45 degrees with $x^1 x^1$.

Having the equation of the curve expressed as in (12) it may be very easily drawn by assuming the position of the vertex o and a convenient value for y^1, as $y^1 = 12$, making $x^1 = \frac{32.4}{c}$. These values are represented by the distances $o\,l^1$ and $l^1 l$ and the parabola may be drawn through o and l by the well-known method sketched in the figure. The point m is readily found by construction. Through any point b on the axis $x^1 x^1$ draw $b\,a = D$ at 45 degrees with $x\,x$, through a, draw $a\,e = d$ perpendicular to $b\,a$. Draw $e\,f$ parallel to $x^1 x^1$, intersecting the curve in f and complete the parallelogram $a\,e\,f\,g$. The line $g\,m$ parallel to $b\,a$ equals $b\,o$ and is the x axis for the pulley diameters, while the perpendicular to it through m is the y axis—that is, the co-ordinates of the curve $o\,l$ represent the proper pulley diameters for constant belt tension.

From Fig. 2 the ratio of the diameters of two opposite steps, as $\frac{y}{x} = \frac{f\,g}{m\,g}$, determines a line through m such that the tangent of the angle it makes with $x\,x$ (that is, the tangent of $f\,m\,g$) is the ratio of the diameters. It follows that any values of x and y must not only be co-ordinates of the parabola, but also of the line through m making the angle with $x\,x$, $\tan.^{-1}\frac{y}{x}$. Let the ratio of any other pair of steps be r. Lay off $m\,t$ and $t\,s$ so that $\frac{t\,s}{m\,t} = r$. The co-ordinates giving the diameters lie on $m\,s$ and also on $o\,l$ or at their intersection h, and the required diameters are $m\,k$ and $h\,k$. The value $\frac{h\,k}{m\,k} = \frac{s\,t}{m\,t}$ represents the required ratio, but this is altered by the belt thickness v and we actually obtain the ratios $\frac{h\,k + v}{m\,k + v}$. If instead of laying down $m\,t$ and $t\,s$ from the origin m they are plotted parallel to the former position from m^1 on $x^1 x^1$ with m^1 distant from the axes of x and y the belt thickness v, we obtain for the diameters the values $m\,k^1$ and $k^1 h^1$, which are correct for the belt tension and give the required velocity ratio, for

$$\frac{h^1 k^1 + v}{m\,k^1 + v} = \frac{h^1\,q}{m^1\,q} = \frac{s^1\,t^1}{m^1\,t^1} = \frac{s\,t}{m\,t} = r.$$

In Fig. 3 is given a complete diagram drawn to scale illustrating the foregoing method in the solution of the following problem: Required, the diameters of the steps of a pair of cone pulleys whose velocity ratios are $r_1 = \frac{1}{2}$, $r_2 = \frac{1}{3}$ and $r_3 = \frac{1}{4}$. Let the diameter of the largest step be $D = 12$, the center distance $C = 36$, and the belt thickness $v = \frac{3}{8}$ inch. The diameters required, $x_1\,y_1$, $x_2\,y_2$ and $x_3\,y_3$, can be found with ample accuracy by scaling, as the diagram is compact enough to be laid out full size without inconvenience. It may be added that the parabola $o\,l$ in Fig. 2 may be replaced with sufficient accuracy by a circular arc with the center on $x^1 x^1$ having a radius equal to the radius of curvature at o. The radius of curvature at the vertex of the parabola $y^2 = \sqrt{2}\,\pi c x$ is $R = 2.22\,c$. When the center is inaccessible, however, it is as easy to draw the parabolic arc as the circle and more nearly correct.

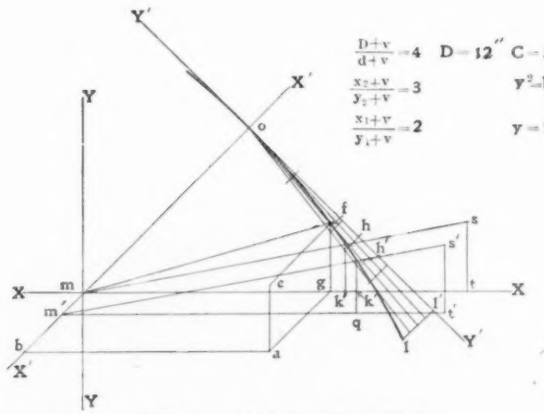


FIG. 2. PLOTTING THE CURVE.

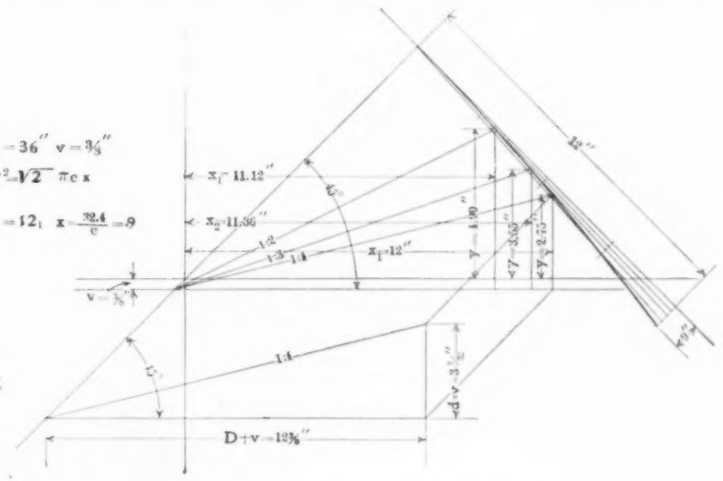


FIG. 3. A PRACTICAL CASE.

A New Metal—Nodium.

United States Consul-General Guenther sends from Frankfort, Germany, the following:

A new metal which is similar to aluminum, but still of lesser weight, has been discovered by the French engineer, Albert Nodon, and called "nodium," after him. It is manufactured by an electric process. In color, luster, and structure it is almost exactly like steel. Its specific weight when molten is only 2.4. Its resistance against breaking is given as about 20 pounds per square of 0.04 inch. Its constancy in the air is higher than that of aluminum. Its ductility is between 6 to 8 inches; the malleability can be compared to that of bronze. It melts at about 600 degrees. It is suitable for being cast into forms. The conductibility for the electric current is as high as that of copper of equal weight. If natural power, especially water power, can be used for its manufacture, the cost in round figures is about 15 cents per pound. The inventor expects numerous uses of nodium in the near future, especially for electric wires and cables, for light but strong parts of motor cars, torpedo boats, men-of-war, street cars, military outfits, air ships, etc., and for castings in place of bronze, German silver, and similar metals. Nothing definite has yet been communicated as to the chemical composition of nodium nor as to the mode of its manufacture.

Letters From Practical Men.

Turning Gear Blanks—Taper Holes in Machine Spindles

Editor American Machinist:

At page 1829, Vol. 26, Frank B. Kleinhans illustrates a special lathe mandrel, which to my way of thinking will not produce good work, for the reason that with so many blanks on the mandrel, the latter, if the blank faces are not exactly true and parallel all the way around, will be bent when the nut is tightened.

It may do good enough work for some purposes, but I certainly would not consider it good enough for turning gear blanks.

Some years ago, having occasion to use a milling machine, I found that in order to do good work I had to use hardened and ground steel collars between the nut and cutter, and use as few of these collars as possible. The cast-iron collars would become charged with fine steel or cast-iron chips which would not rub off easily—in fact, could not well be seen, but which would cause the cutter to run out badly.

I would like to know how much Mr. Kleinhans' mandrel runs out at the outer end when the blanks are screwed up ready for turning; also how large in diameter the blanks are, what the width of face is, the size of the bore, and the number placed on the mandrel at one time.

Mr. Kleinhans says at page 1785, third column, that when boring a taper hole in a spindle with the taper attachment, and the taper is set all right, and the hole then bored to the required size, the test bar when tried with the indicator will almost surely be out considerably. This is a point to which I take exception, claiming that it is impossible to bore the hole otherwise than absolutely true. How can anyone bore a hole in the lathe that will be out of line? You may bore it at any angle by chucking the rear end of the work out of line, but while the piece is in the lathe and you insert a test bar, that bar will certainly run true.

This brings to mind a job of taper boring performed some years ago where the hole was about 6 inches in diameter, 3 feet deep and ½ inch taper in this length.

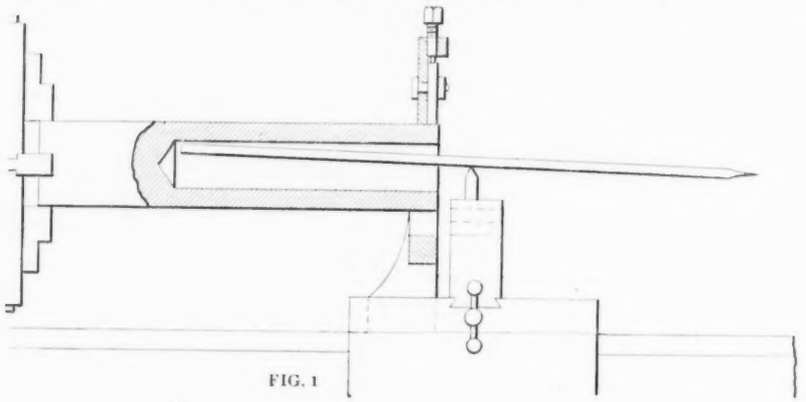


FIG. 1

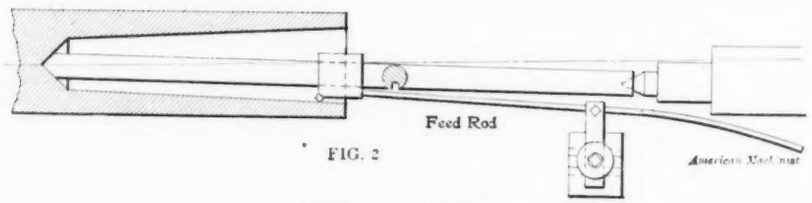


FIG. 2

BORING A TAPER HOLE.

The forging, as this happened to be, was about 5 feet long, and after the hole was drilled, we tested the inner end of the hole with a small bar (see Fig. 1) at four points, after which we inserted a boring bar which centered in the conical seat made by the drill. Said bar had a keyway milled in one side its whole length. A head sliding on this bar carried at its front end a cutter and was moved along the bar by a rod which was screwed into the back end of the sliding head and fastened, as shown in Fig. 2, to a clamp held in the tool-post. The bar was prevented from turning by a rod driven in a hole at the tailstock end of the bar, this rod being long enough to reach the bed of the lathe. The tailstock was set over the required distance and we were then ready for business.

This was not a fine-haired job, but if it had been, I should have made a brass plate to fit in the front end of the hole with a spherical recess, and made the end of the bar to fit.

A. MERTES.

An Old Iron Furnace.

Editor American Machinist:

The photograph shows what remains of an old iron furnace, situated at the foot of the mountains several miles from Milton, Pa. In this vicinity it is commonly known as "The Furnace."

The wheel and the three cylindrical tanks above it were the arrangements for furnishing the air blast. The wheel is of the over-shot type, the water flowing through a race from a creek about a mile away. The two outside cylinders were the ones that supplied the air while the middle one was used for the air reservoir, the air flowing from the reservoir into the furnace. The wheel is about 30 feet in diameter, and is built on a huge wooden shaft, the shaft running in iron boxes. At each end of the shaft is a cast-iron crank giving a stroke of about 3 feet. Wooden connecting rods, fitted with iron boxes, connect the cranks with the piston rods. The air is sucked in through the bottom of the cylinders, and then forced into the

OLD FURNACE NEAR MILTON, PA.

reservoir, the upward stroke sucking the air in and the downward stroke forcing it to the reservoir.

The cylinders are built up of layers of inch lumber and are not lined, the joints being made as smooth as possible so as to make a good fit with the heads. These cylinders are still in a good state of preservation, although they have not been used for a good many years, while the wheel is about ready to fall down. At present, parts of the stonework are covered with ivy vines, giving a very picturesque appearance. W. G. K.

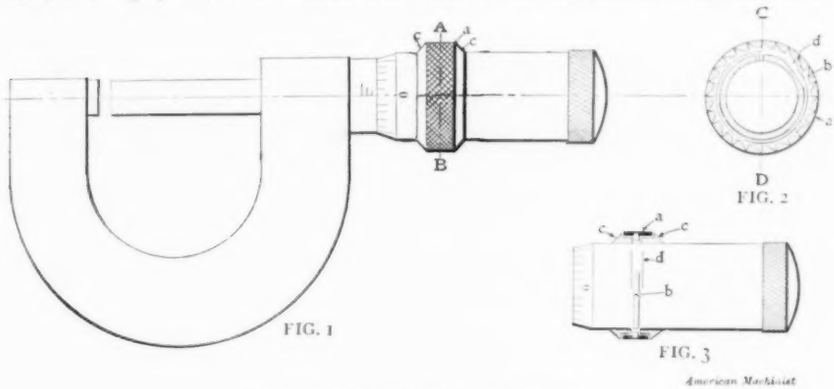
Ratchet Stop for the Micrometer.

Editor American Machinist:

A constant use of the micrometer has convinced me of the many good points of the ratchet stop, or, as I prefer to call it—I think more correctly—the sensitive feed. But the use of this excellent feature has hitherto been largely limited by the great disadvantage of its position at the extreme outer end of the spindle, and the consequent inconvenience of operating, as a result of which most users depend entirely upon their sense of touch for accuracy of measurement; this often means a variation in the micrometer reading in the hands of different men, while those less skilled in its use not infrequently strain the instrument.

To overcome this objection, I some time ago devised and applied to a micrometer the ratchet or sensitive feed as shown, and as it has been highly approved by all who have seen and tried it, I thought it might be advisable, and—incidentally, of course—to my advantage, to make it more widely known.

Fig. 1 shows the tool with the device in place; Fig. 2 is a sectional view on line *A B* of ring *a* and thimble, showing the spring or spring pawl *b* between them; and Fig. 3 shows the thimble with



RATCHET STOP FOR THE MICROMETER.

ring *a* and collars *c c* cut in two on line *C D*, and the free end of the spring pawl *b*. The supporting collars *c c* hold in place the knurled ring or collar *a*, the internal central rib of which is provided with teeth, as shown; these teeth engage the outwardly-bent free end of the spring *b*, the other end of which is secured to the thimble.

In operation, when rotation of the thimble through the collar or ring *a* brings the spindle in contact with the object being measured, the spindle and thimble come to rest while the collar is rotated, the internal teeth depressing the free end of spring pawl *b*, to allow for which action the thimble is recessed at *d*. Rotation in the reverse direction obviously causes positive engagement of teeth and pawl, and consequent withdrawal of the spindle.

An additional advantage of this form of sensitive feed is that it is equally applicable to the micrometer in all its forms—hight and depth gages, inside micrometers, etc.—on which the other kinds cannot be used. C. W. PITMAN.

A Quadruple Splining Fixture—Drill Holder for Screw Machine.

Editor American Machinist:

The splining fixture here shown is made for splining 7/8-inch rods 36 inches long, four at a time, with a gang of cutters. The clamps are milled off at an angle of 45 degrees and hold the work down and also against the side of the fixture. The holes in the clamps are 1-16 inch large to allow them to float, and they are provided with a pin to keep them from turning.

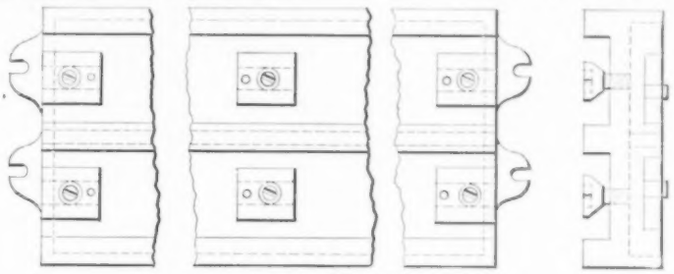


FIG. 1. QUADRUPLE SPLINING FIXTURE.

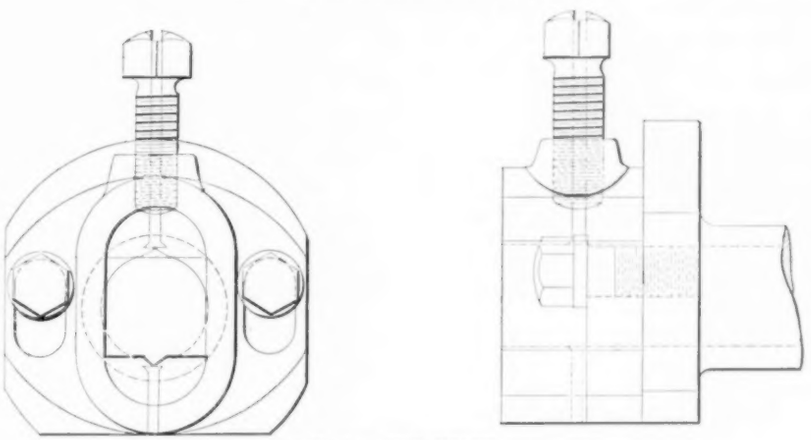


FIG. 2. DRILL HOLDER.

The drill holder is made of machine steel, case-hardened, with the exception of the jaws, which are of tool steel tempered and held in place by 1/8-inch pins. This holder may be used either floating or solid and takes drills from 3-16 to 7/8 inch.

W. E. WILBER.

"Christening a Gas Furnace."

Editor American Machinist:

The letter of H. T. Green at page 198 is certainly a very graphic account of the inexcusable behavior of a gas furnace. It shows plainly how careful we should be in adopting new fangled devices. In this instance the mischievous progressive spirit constantly suggesting departures from the practices of our grandfathers, has manifested itself in a particularly aggravating manner; showing plainly that the introduction of two such new-fangled devices as the automatic sprinkler and a gas furnace, in one shop, is incompatible with sound mechanical principles.

But it may well be questioned whether even the absence of the sprinkler would have prevented the trouble entirely. The furnace seems to have been one of the kind occasionally constructed for the purpose of meeting a purchaser's views with reference to prices. This is plainly indicated by the statement that the "two other burners were lighted," that "some small

pieces were heated in the *forge blast*," and that "the belt on the air-blast pump came off." The thing was too complicated.

With sincerest sympathy for the victims of the mishap, we can assure them that nothing would be more proper than to heat their "large blanking dies" in a gas blast furnace, properly made, placed and operated. It can furthermore be said that the makers of such furnaces would furnish a man to put it up and run it for the asking, leaving it optional with the intending purchaser to keep it or not as he might elect after trial. It is the concurrent sentiment of hundreds, nay, thousands of first-class manufacturers that gas blast furnaces, properly constructed and intelligently used, are among their best paying investments. They facilitate heating processes amazingly and reduce the risk incurred by our grandfathers, in hardening a die block, to a minimum.

But, after all, it must be admitted that sprinklers and gas furnaces—or even the venerable coal-heated furnaces—should be kept apart; and if the mischievous "progressive spirit" brings them close together, separate them by all means, by the interposition of a piece of sheet iron.

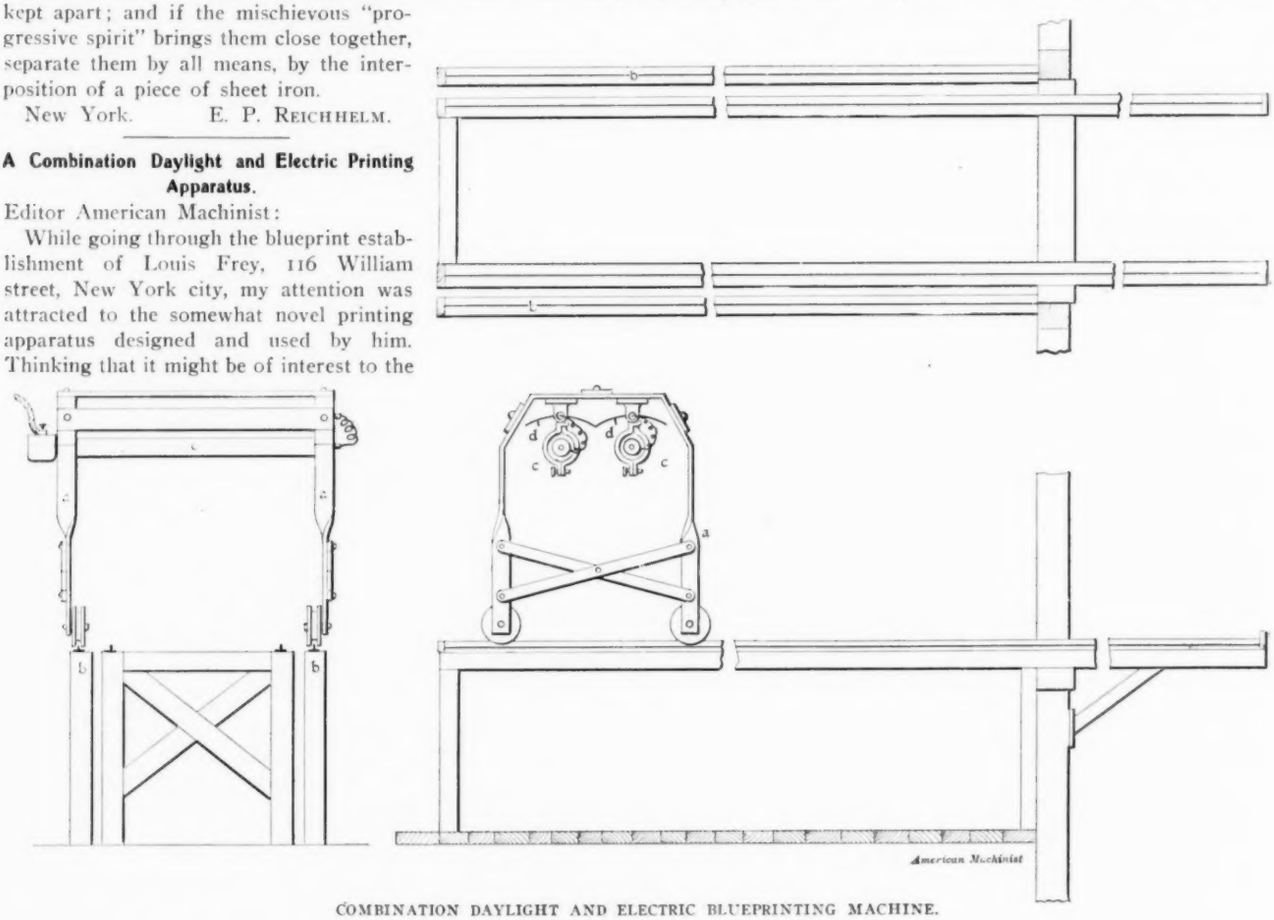
New York. E. P. REICHHELM.

A Combination Daylight and Electric Printing Apparatus.

Editor American Machinist:

While going through the blueprint establishment of Louis Frey, 116 William street, New York city, my attention was attracted to the somewhat novel printing apparatus designed and used by him. Thinking that it might be of interest to the readers of the AMERICAN MACHINIST, I obtained Mr. Frey's permission for the following description: The apparatus takes up no extra floor space, and it can be applied without altering the ordinary blueprinting apparatus. The electric-light carrier *a* straddles the printing frame and travels on separate runners *b*, as shown. With this arrangement we have a most useful and advantageous combination of a daylight and electric printing apparatus, each independent of the other. The electric attachment equipped, as shown, with two 750 candle-power Cooper Hewitt mercury vapor tube lights *c* and reflectors *d* proves very efficient and economical, making a print in from one to two and a half minutes. The Cooper Hewitt light is especially adapted to all photographic purposes on account of the extremely actinic property of its rays. When printing the electric carrier is moved back and forth over the printing frame.

RALPH C. DAVISON.



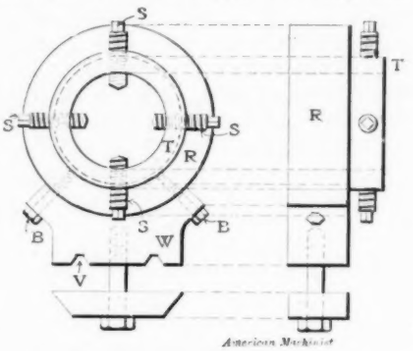
COMBINATION DAYLIGHT AND ELECTRIC BLUEPRINTING MACHINE.

A Rotating-Bearing Steady Rest.

Editor American Machinist:

The steady rest shown in the sketch was made for our own use in threading large and long pipe in the lathe. It is made mostly of piston ring stock and 1-inch round iron. The solid ring *R* is fastened into the standard by the two screws *B*. The ring *T* is fitted to turn in *R* and in the thick, projecting part it has four screws *S* which can be adjusted to pinch the pipe. Threads can be cut at the end of a long pipe by chucking it by the inside, setting the pipe an eighth of an inch or so away from the chuck face, to allow the threading tool to cut to the end. Of course the size and length of pipe handled, without turning end for end, depends on the swing of the lathe and the length of its bed.

Besides being almost indispensable in cutting long pipe in a short lathe, this rest will often help one out on jobs where the common rest is almost useless. It can be used for pieces that are not turned and not even round in shape. To adapt this rest to a large range of sizes, two or more sets of screws are required. The rotating ring is shouldered only on one side, so that it can be slipped out and slipped in the other side of the standard when more convenient.



A ROTATING BEARING STEADY-REST.

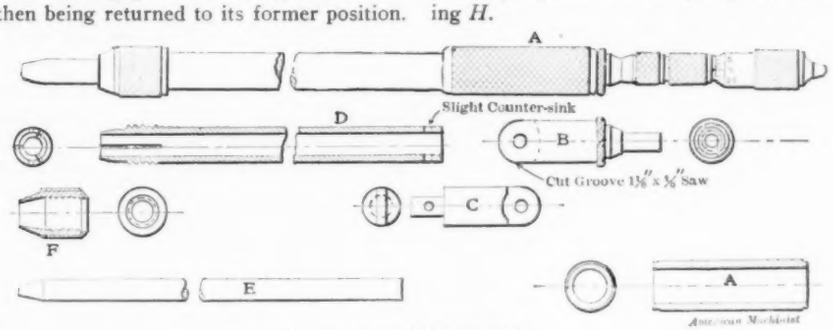
REPAIR SHOP.

Inside Micrometer Gage.

Editor American Machinist:

The micrometer gage shown in this sketch is used not only for ordinary inside work but also for taking the diameters of recesses in parts similar, say, to

eccentric straps, the recess being calipered and the gage removed without losing the size. This is accomplished after the gage is set by sliding sleeve *A* back, thus allowing the head *B* to be swung to one side while the gage is removed, the sleeve then being returned to its former position.



INSIDE MICROMETER GAGE.

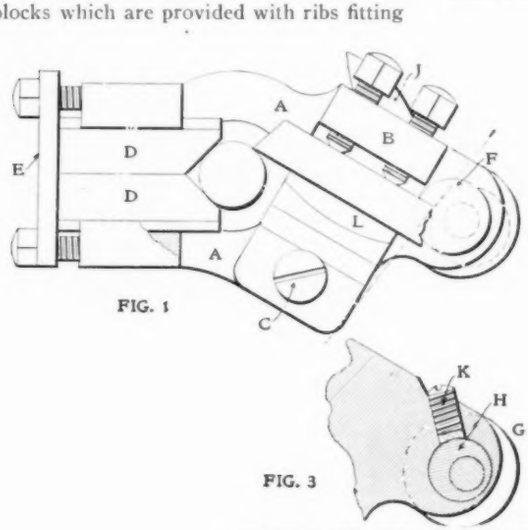
In making this gage, *B* is turned on the end so as to allow a Starrett inside micrometer gage to clamp thereon. The other end of *B* is slotted to fit the tongue on *C*, these two parts being held together by a small rivet. The small end of *C* is made a driving fit and pinned in tube *D*. This tube has three narrow saw-cuts in the end so that it may be clamped to rod *E* by means of knurled nut *F*.

After the gage has been put together, it is made to run true between centers; the hinged joint is then soft-soldered, to hold the gage true while being ground to suit sleeve *A*. C. S.

A Turning Tool for the Turret Lathe.

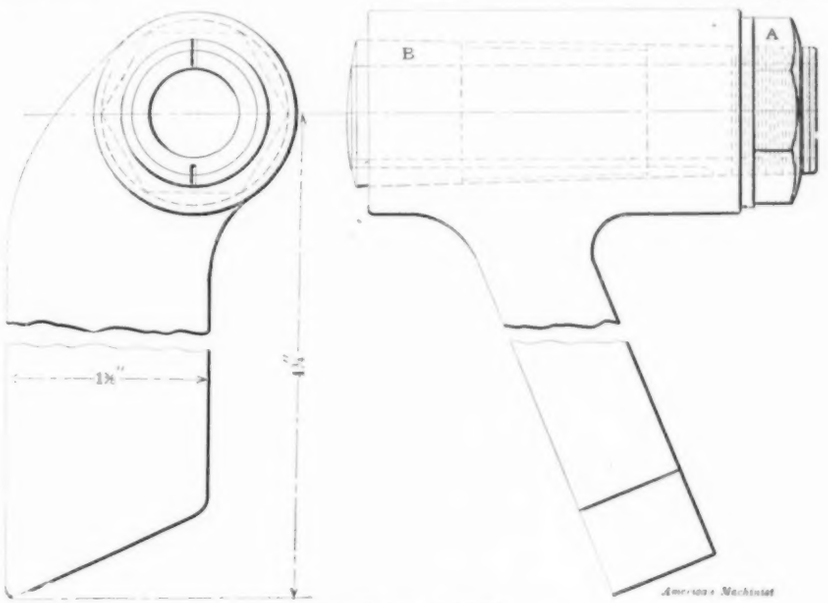
Editor American Machinist:

I enclose a drawing of a turning tool for use in the turret lathe. Referring to Fig. 1, *A* is the main part or body of the tool upon which is mounted the tool-holder *B* pivoted at *C*. *D D* are back-rest blocks which are provided with ribs fitting grooves formed in the rear portion of the body; and *E* is an adjusting strap which rests against the outer ends of the blocks and is held in position by two screws. At *F*, Figs. 1 and 2, is a cam or eccentric formed on shaft *G*, and this shaft is carried in an eccentric bushing *H* fitted into body *A*. Mounted on the other end of the cam shaft and fastened thereto by the pin *I* is the handle *J*. *K*, Fig. 3, is a screw at the end of which is a piece of rawhide pressing against the periphery of bushing *H*.



A TURNING TOOL FOR THE TURRET LATHE.

In operating the tool, the handle is pressed forward, turning shaft *G* so that the highest point of the cam or eccentric comes in contact with the tool-block *B* and forces the same into its forward position; and when in this position the tool is ready for work. After the cut has been taken the handle is pulled in the opposite direction, thus allowing the tool-block to fall back into the position indicated by the dotted line in Fig. 1, lifting the cutting tool off the work, and enabling the operator to withdraw the tool without marking the work surface. The tool is set to turn the required diameter as near as possible by means of the hardwood shoe or rocker *L*; but, as this is not a very convenient means of adjusting the tool closely, I have provided the eccentric bushing *H* for fine adjustment, the bushing being turned by a small spanner wrench engaging holes *M*, Fig. 2, drilled in the bushing head. The shank of this tool is fitted to the turret holes and bored out as large as is consistent with strength, to allow for turning long pieces. I have reduced 1¾-inch



BORING-TOOL HOLDER.

round machine steel to a diameter of 5/8 inch in one cut with this tool on an old-fashioned turret lathe. GEO. J. WINKLE.

Boring Tool Holder.

Editor American Machinist:

The accompanying sketch shows a boring tool holder, the tools being made from drill rod or any other finished stock. The boring tool is firmly clamped by the nut *A* and the taper bushing *B* which is made of tool steel and spring tempered. This bushing has a narrow saw cut through one side while the other side is cut deep enough with a round corner saw to admit of its springing easily. The bushing is relieved for a distance of 1¼ inches in the center, thereby causing it to clamp firmly at each end of the holder. That part of the holder which clamps in the tool-post is made at an angle with the tool to allow the holder to be used close to the face-plate or chuck. Another advantage of this holder is that when adjusted for hight by the shoe in the tool-post the tool remains practically parallel with the work.

S. C.

Ball Bearings With Four Point Contact.

Editor American Machinist:

Some years ago there appeared in the AMERICAN MACHINIST a description of a new ball bearing in which each ball had four points of contact instead of two, as is usually the case, but no explanation was given as to the method of determining the outline of the groove required for perfect action. The following graphical method may assist some to reduce their ball-bearing difficulties.

Having decided upon the number and size of the balls to be used, the radius of their pitch circle is found by the formula:

$$R = \frac{r}{\sin. \frac{1}{2}\theta} \qquad (1)$$

in which R = pitch radius,
r = radius of ball,
θ = angle of ball, Fig. 1,

$$= \frac{360°}{\text{number of balls}} \qquad (2)$$

Assuming the number and size of the balls to be 24 and ½ inch, respectively, we have, from (2)

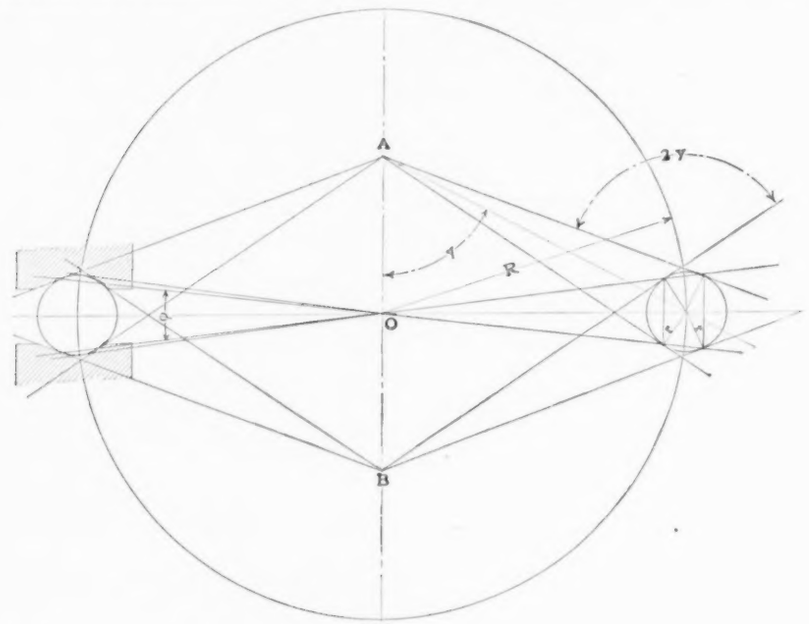
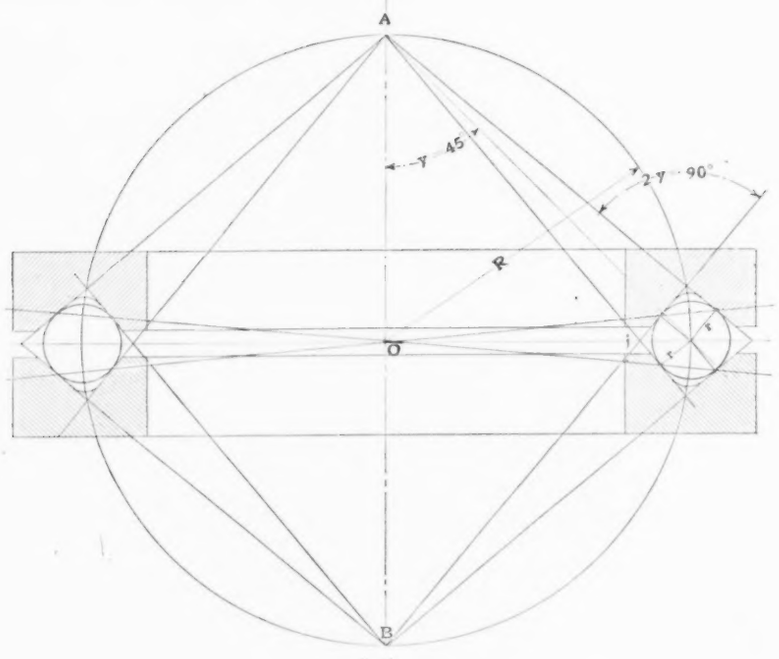


FIG. 1



BALL BEARINGS WITH FOUR POINT CONTACT.

$$\theta = \frac{360}{24} = 15°,$$

$$\tfrac{1}{2}\theta = 7\tfrac{1}{2}°.$$

From (1) and a table of sines

$$R = \frac{.25''}{.13053} = 1.915'',$$

use $1\frac{29}{64}'' = 1.922''$.

Lay out to an enlarged scale the pitch circle, Fig. 1, and upon this circle one of the balls to the same scale. Take any two points A and B equidistant from the center O, and from these points draw the tangents $A\,b$, $A\,e$, $B\,a$ and $B\,f$. The angles $A\,g\,h$ and $B\,c\,h$ give the required grooves and in their proper position as regards the axis of rotation $A\,B$, so that they may be easily measured with a protractor.

The condition that must apply to insure perfect action without slipping at any point, is that if an element of a cone having its apex at O be drawn through either of the points of contact a or b, it will also pass through the other, and this is insured by the construction shown.

The distances $O\,A$ and $O\,B$ may be assumed at pleasure, depending solely upon the angle of the groove which is considered best for the case in hand.

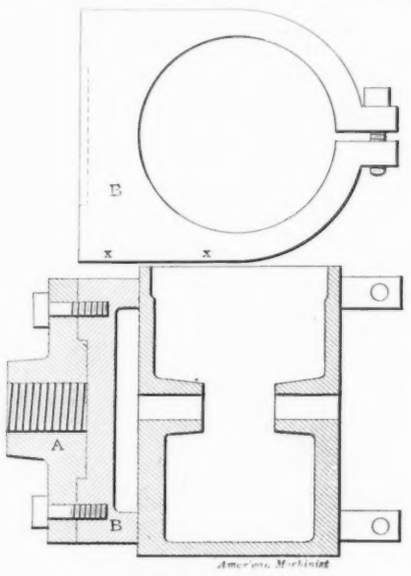
If, as in Fig. 2, we use $O\,A = R$, then angle y becomes 45 degrees and the angle of the ball groove becomes 90 degrees.

[The same layout of the grooves as this, though obtained by a different geometrical construction, was shown in an article by Fred J. Miller in our issue for April 3, 1890. The construction is obviously adapted to step bearings only.—Ed.]

Machining Gas Engine Pistons.

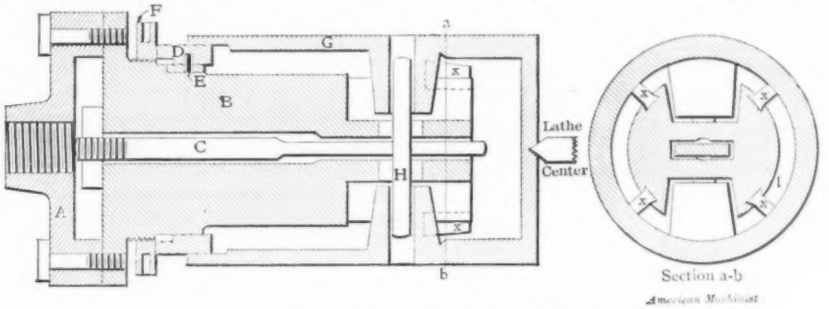
Editor American Machinist:

Some parts of gas engines are out of the ordinary and require special fixtures to machine them quickly and correctly, and this is especially true of the trunk piston so generally used. The casting is cored out and with the most careful molder it may vary in thickness; it should therefore be centered by the inside. I designed a simple chuck for this purpose shown in Fig. 1. A casting A is fitted to the lathe spindle and finished in place. Fitted to this is casting B, which has a hole cored lengthwise through it, flat half its length and round the rest. In this cored hole is a steel bar C. At the outer end of casting B are four small pieces



BORING THE CROSS-PIN HOLE.

x x x x of tool steel dovetailed in, turned tapering on their outer edges, and hardened. The open end of the piston is first bored true with the inside and reamed taper, and *D* is a steel ring turned the same taper and held from turning by pin *E*, which slides in a spline. It is set up to the piston by screw collar *F*. *G* is the piston casting in place. A flat pin or key *H* is passed through the transverse cored hole in the piston and also through bar *C*. The nut on *C* is tightened and the piston is drawn on to and centered by the four steel pieces, then ring *D* is set up and the piston is thus centered by the inside at both ends, and is firmly held for turning and grooving for packing rings. Four holes are drilled in ring *D* to take the end of the steel pin to pry off the piston when finished.



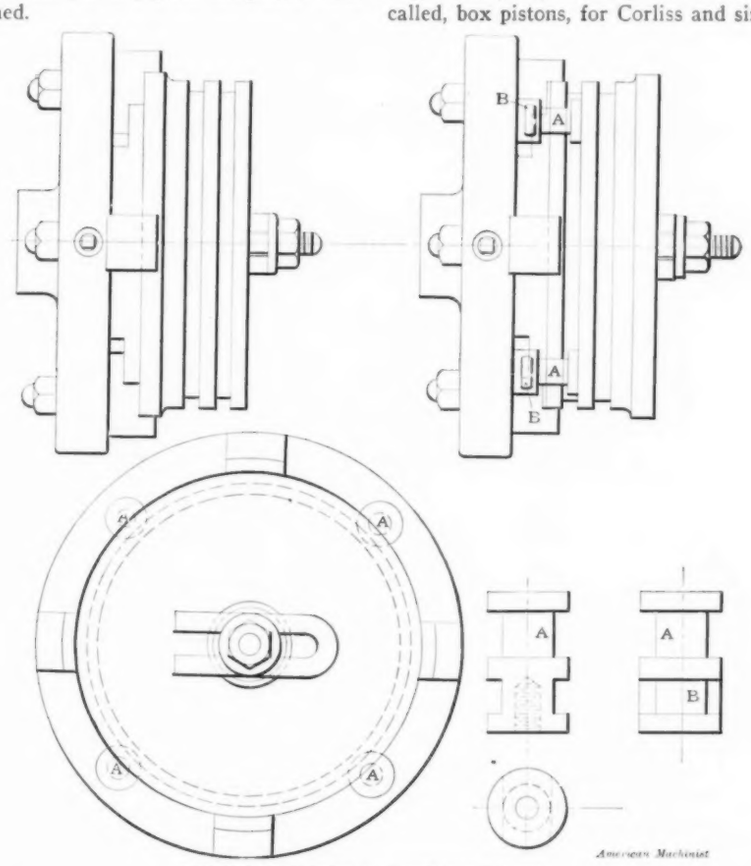
CHUCKING THE PISTON BY THE INSIDE.

of the piston. Fig. 2 shows a chuck for this job. A casting *A* is fitted to the lathe spindle and finished as shown. Casting *B* is planed on the side at *x x* so as to fit true on an angle-plate set on the face-plate of a lathe. It is centered, faced and recessed to fit *A*, then turned around on the angle-plate so as to bring the faced surface square with the face-plate and the holes that receive the turned piston are bored to fit. The use of this is plain, and if carefully made it will do perfect work; at least mine does. J. S. ROUNCE.

Turning Box Pistons—Distance Pieces for Setting.

Editor American Machinist:

The sketches show a method of turning large solid, or, as they are sometimes called, box pistons, for Corliss and similar



TURNING BOX PISTONS WITHOUT FACING.

When so finished the next operation is to bore out the transverse cored hole for the connecting-rod pin. This hole must be square to and central with the axis engines. The piston is mounted in a four-jaw independent chuck in a surfacing lathe by Messrs. Lang, of Johnstone, which is eminently adapted for this purpose. The cored hole in the center is first bored out to a templet to which the piston rod is made, being tapered 1 in 6. A stud is then screwed into the tapped hole, in lieu of the usual taper center hole in the spindle, and a nut outside with washer and strap secures the piston in the chuck and helps to keep it rigid under heavy cuts. It is then turned as far as the jaws will allow and grooves are cut in for two rings. The piston is then turned around to have the remaining portion turned. These pistons not being surfaced on the back or front do not present a true surface to the chuck jaws when tightened up by the central stud, so we made four setting or distance pieces as shown, which greatly facilitate setting and save much time. These distance pieces are made out of round bar shafting about 2¼ inches diameter reduced to 1 inch diameter at *A*, the other portion being left black, with two flats cut on for a spanner at *B* and a ¾-inch hole tapped in the bottom. They are fastened to the chuck plate by cap-screws pasing through holes between the jaws, as shown in the front view, and the ends are just skimmed with the tool, insuring their all being one dead length. Looking at the view of the second operation, it will be seen that the back surface of the piston is not drawn up against the chuck jaws by the center bolt, but stands quite free; the turned heads of the distance pieces resting against the edge of the inside groove, set the piston dead true with the turned groove, the chuck jaws being easily adjusted for setting it radially. W. D.

L——, England.

Getting Out a Broken Tap.

Editor American Machinist:

A friend of mine had a tap break the other day, a piece of it being left in the work. When I arrived upon the scene, he was trying to get it out with the aid of hammer and chisel. His usual procedure in such cases (which I believe is the method generally adopted) was to heat up the work, if not too large, till the broken tap was soft enough to allow a hole to be drilled in it and then knock in a square punch, by which means the broken piece

FOR GETTING OUT A BROKEN TAP.

can sometimes be removed. In the present case it was impossible to use this method, as there were aluminum parts attached which would be spoiled if made hot. With the aid of a blowpipe broken taps can sometimes be softened without damaging any of the surrounding parts, as the flame can be directed upon the tap alone. Seeing the trouble in this case reminded me of the little tool shown in the accompanying sketch which I first made the acquaintance of many years ago. During my apprenticeship I had broken a tap

in a valuable piece of work which was very urgently wanted. I tried all the ways I could think of to get it out, but all to no purpose. I was afraid to show the foreman what I had done, so I asked the advice of an old hand who had previously put me up to many little kinks. He quickly made a tool like the one shown, and soon had the broken piece out. As will be seen, the three projecting parts go into the corresponding grooves of the tap. The diameter of the tool should of course be a little less than that of the bottom of the thread. CHERRY RED.

Coventry, England.

[The device of our correspondent, like the others he speaks of, is not always applicable. It is probably the exception rather than the rule for taps to break off square, and when they do not this device is not generally applicable. At page 68 we showed a tool for this purpose now manufactured for the trade which is more or less adaptable to the difficult cases of irregular fracture.—Ed.]

Compound Punch and Die for Armature Disks.

Editor American Machinist:

The drawings will show a compound punch and die for punching in one operation a sheet-steel disk 9⅛ inches in diameter and 1-32 inch thick with thirteen holes in it of different sizes and shapes. The disk produced is sufficiently indicated in the plan of the die, Fig. 1, where the inner circle represents the outside of the disk and the holes in it are those marked *C*, *B* and *D*. The small circles *K* have another function which will be explained.

The die is fastened to the ram and forms the top part, the punch being fastened on the bed of the press and forming the bottom part. The die is composed of an outer steel ring *A* bored to the size of the outside diameter of the blank. A number of steel punches *C B D* the shape of the holes required in the blank are fastened to the cast-iron plate *J* with screws *G* or nuts *I*. A steel stripper *F* is held in position by screws *K* and springs *E*.

The punch is made of a round block of steel *B* turned to the size of the blank and fitting between the cutting edges of the die. This block or punch is fastened to a cast-iron holder *A* by screws *F*. Die holes *I G H* are cut out, fitting the corresponding punches in the die. A steel stripper *C* is held in position by screws and springs *E D* and fitting loosely over the punch. When the ram of the press comes down the inner cutting edge of the die ring comes in contact with the cutting edge of the punch, also the inserted punches *C B D* in the die simultaneously enter the corresponding openings *G H I* in the punch block cutting out the blank complete and forcing it into the die. When the ram goes up the finished blank is ejected from the die by the stripper *F* actuated by the springs *E*, and it falls on the top of the punch. The waste metal also is forced off the outside of the punch by the stripper *C* actuated by its springs *D*. The blank and the waste are then removed by hand. The punchings in the openings *H I G* fall through the bottom of the press.

H. ROBINSON.

A Shop Owner Who Does Not Care for High-Speed Steel.

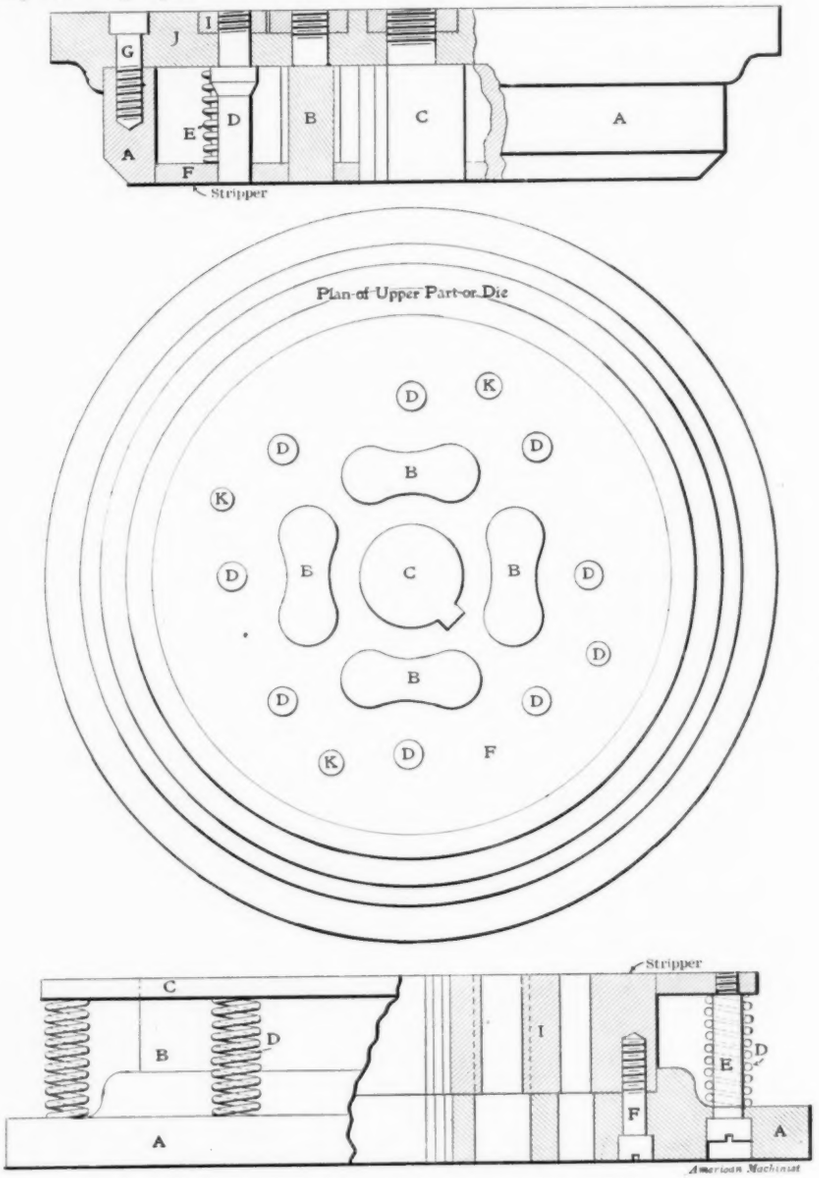
Editor American Machinist:

I have read lately about the wonderful amount of work that can be turned out in a day with high-speed steel. While we may be able to turn out more work with a first-class high-speed steel than we can with the ordinary tool steel, I think the saving is greatly exaggerated.

For example, provided you can by the use of high-speed steels increase the speed of your machine tools 50 per cent., it does not signify that you are saving even 10 per cent. in the cost of the machine work. There are several points to be considered in figuring the saving to be made by the use of high-speed steel. The cost of high-speed steel is many times that of a good ordinary steel. Does it not take the blacksmith much longer to dress and temper the high-speed steel? and is he as sure of a good job when he is through?

I have found, in taking the welding heat to temper the high-speed, that the nose or point of the tool must be practically melted off or the tool will not stand up, and that means a long, hard grinding job to get the tool in good shape for the machine.

Then in tempering the tool you must take a very short welding heat, and must always have a very small fire for the purpose, consequently the temper extends back only a short distance and the tool must be retempered very frequently. In considering the saving by the use of high speed, we must remember that neither steel gains any advantage while the work is being set in the machine and trued up, and this sometimes consumes as much time as doing the work.



COMPOUND PUNCH AND DIE FOR ARMATURE DISKS.

The question arises: Will the average high-speed steel stand as heavy a cut as a good ordinary tool steel? My experience has been that it will not. I recently tried two different makes of high-speed steel and had a great deal of trouble with the tools breaking square off at the edge of the tool-post ring. These tools were forged from ¾x1½-inch stock, and were used in a 24-inch lathe, turning low-carbon open-hearth steel. After breaking these tools, with a tool I made from the old reliable, I decreased the speed, but could increase the feed and depth of cut, and made as good time with the ordinary steel as with the high-speed. This has been my experience with two different makes of celebrated high-speed tool steel, and the cost of broken steel, lost time in dressing, grinding and tempering do not help the high-speed out any in my estimation, when figuring the relative merits of steels.

D. E. NORRIS.

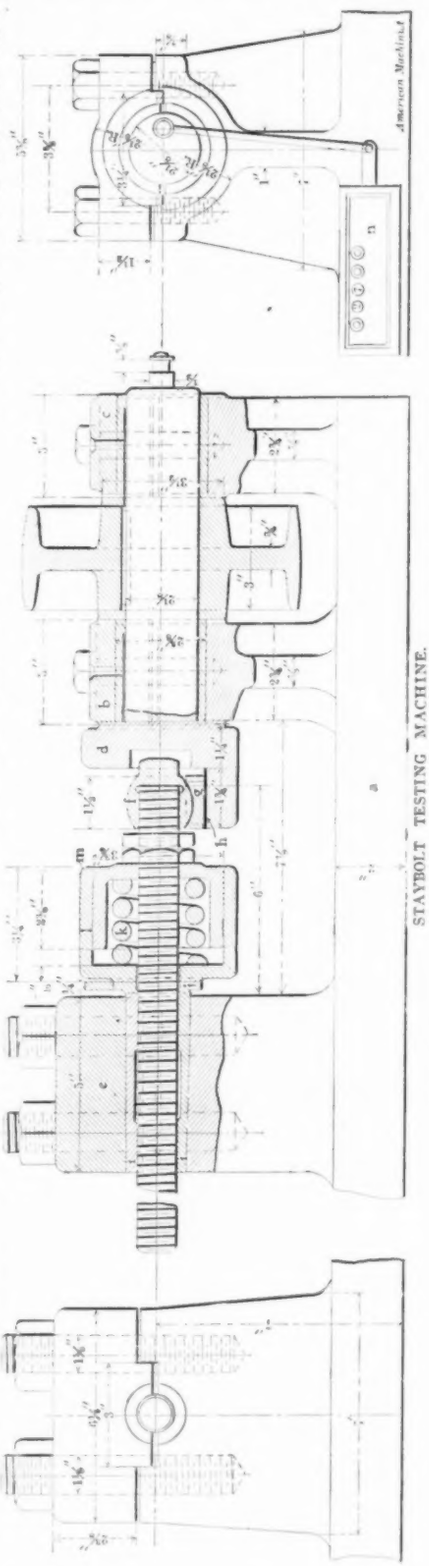
Tiona, Pa.

A Staybolt Testing Machine.

Editor American Machinist:

No doubt there are some in the boilermaking business who are required by purchasers' specifications to give their staybolts a vibratory test, and for this reason I am prompted to send the accompanying drawing of a machine for making such tests that has been improved upon from time to time until it has reached the stage shown. It will save its cost in test and freight bills in a short time. Its cost is small, and it will give good results. I recently saw a set of specifications that required the bolts to be tested in a machine of this kind, the specifications requiring that the bolt be held rigidly 6 inches from the free end, that it have an applied tensile strain of 2,400 pounds per square inch, that the free end be moved in a circle whose plane is at right angles to the axis of the bolt and having a radius of 1-16 inch, and that the machine be driven at the rate of 100 revolutions per minute. When thus tested, bolts to be accepted must stand not less than 2,500 revolutions for ⅞ inch, 2,000 for 1 inch, and 1,500 for 1 1-16 inch bolts.

The frame *a* is made of cast iron, one end having two bronze bushed bearings *b* and *c* for the crank *d*. The opposite end at *e* clamps the bolt to be tested. At *f* is a 2-inch hardened steel ball tapped and screwed on the end of the bolt under test, at *g* is a loose bronze block forming the socket for the ball, and at *h* a steel shim 1-16 inch thick, which is slipped under the socket to give the required radius to the end of the bolt. At *i i* are two halves of the steel clamp bushing, to hold which as rigidly as is necessary it has been found necessary to use four 1⅛-inch binder studs. The bushing is tapered, being slightly larger at the front end. The hardened steel washer *j* fits in the concaved front ends of the bushing *i i* which keeps the spring *k* and spring case *l* parallel with the bolt. The spring is of ⅝-inch steel and is 2¾ inches outside diameter, being made to exert 2,400 pounds per square inch of bolt when the outside edges of the spring



box are flush as at *m*. This gives strains and movements not altogether dissimilar from those of service. A revolution counter *n* is attached at one end and completes the device.

T. B. BURNITE.

Another Section Liner—Lettering Tracings Without Drawing Base Lines—Centering Titles on Tracings.

Editor American Machinist:

I take great pleasure in reading the many interesting hints to draftsmen published in the AMERICAN MACHINIST, and was especially pleased with the article at page 60 on "Photography as a Time Saver." An isometric drawing is certainly most unsatisfactory in many instances. Inking in or tracing the outlines of a photograph, as suggested in the above article, is a very simple matter, and it is surprising what pleasing results one can obtain when a little care is used.

The section liner shown at page 126 prompts me to call your attention to a very simple one that I have used for some time. It consists of a piece of cardboard cut out to fit loosely the opening of the triangle, the looseness determining the width of space between lines and a different piece being necessary for every different width of lining. It takes but a minute to cut these pieces out, and when once made they can be lettered 1-16 inch, ⅛ inch, ¼ inch, etc., according to the different widths of section lining they have been made for, when they can be put away and are always ready for use when wanted.

For cross-sectioning tracings the quickest and simplest way is not to use a cross-section liner at all, but to lay beneath the portion of the tracing to be cross-sectioned a piece of cross-section paper, which can be procured at almost any draftsmen's supply store. Trace every line or every other line, according to the width of cross-sectioning desired. A line drawn at 45 degrees across the section paper makes a very convenient guide for quickly adjusting to the proper angle.

The majority of blueprints one comes in contact with show light lines about the lettering, indicating that pencil lines had been drawn on the tracing cloth to be used as guide lines.

To save time and to make the drawing look neater, I use a piece of cardboard having lines for different sizes of letters ruled upon it, which is slipped under the tracing cloth in any desired place and. the lines showing through boldly, provide an excellent guide for the lettering and at the same time assure uniform size of letters.

R. C. D.

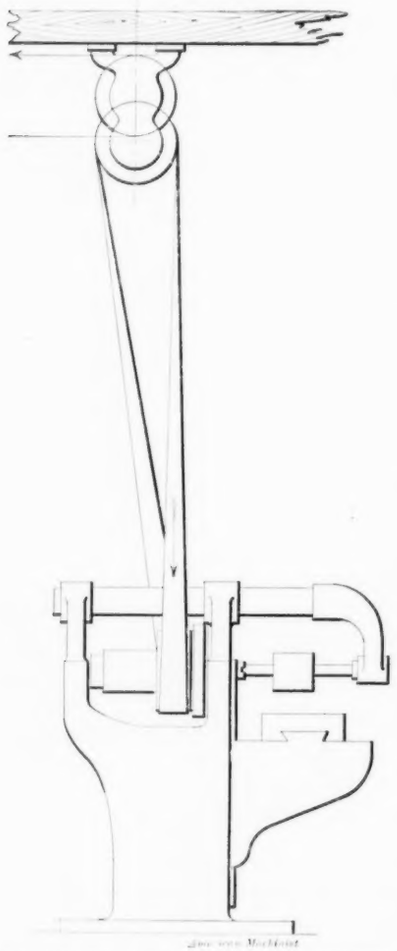
[Our correspondent's last suggestion reminds us of a scheme for assuring the centering of the various lines of the titles of tracings without laying them out. The title was roughly lettered on a piece of squared paper with little regard for centering, and this paper was then placed below the tracing in the manner described. The first line of the title being lettered on the tracing, the paper was shifted until its second line was centered with the first line on the tracing, when this second line was copied, and so on to the end. The lines of the paper served also the purpose described by our correspondent.—Ed.]

Economic Location of Machinery by Using a Variable-Speed Countershaft and Quarter-Twist Belt.

Editor American Machinist:

The greatest difficulty in the economic location of small machinery consists in not having room enough for countershafts, belting, etc. As none of these machines require a great amount of power, they are, in nearly every case, bunched together and driven by a motor through a short line shaft.

As different machines are arranged with a driving pulley either parallel or at right angles to the face of the machine, depending upon its style and make, we are frequently at a loss in knowing how to belt our machine through a form of right-angle drive.



THE USE OF A VARIABLE-SPEED COUNTERSHAFT IN CONNECTION WITH A QUARTER-TWIST BELT.

In the illustration we have a milling machine which is to be placed in a group of other machines, and owing to the length of the work which we desire to do on it, it is necessary that the machine be located at right angles to the line shaft. This is accomplished by the use of a quarter-turn belt from a variable-speed countershaft. As it is not necessary to reverse the direction of the cutter on the milling machine, we can lead direct from the countershaft to the milling machine, without using an idler to deflect the belt.

Also in the location of the machinery in the lathe department, economy of room is frequently possible by placing a number of lathes at right angles to the length of the building, and thus also at right angles to the line shaft. By the usual methods this is practically impossible without using a right-angle belt drive or else rigging up a special line shaft and motor by which to drive these machines.

By placing a thread indicator on the lathe to avoid the necessity of running it backwards in thread cutting, the same arrangement becomes feasible, and the same is true of many other machines.

FRANK B. KLEINHANS.

Gas Engine Tools and Fixtures—Machining Piston Rings.

BY LUCIEN I. YEOMANS AND CHAS. E. SIGLE.

Piston rings come to the shop in the rough from the foundry, in the form of eccentric cylindrical shells, of a length sufficient to produce from ten to twenty finished rings, the number determined by convenience in machining. These shells have at one end of each three equidistant outwardly extending lugs in which slots are cast, by means of which they are bolted to a bell centering chuck on a Gisholt turret lathe.

The outside is turned .175 inch larger than the diameter of the cylinder by a tool in the carriage of the lathe, and the eccentric interior is bored at the same time by a tool having longitudinal movement only upon an eccentric rotating bar, one end of which is held rigidly in the lathe spindle and the other is supported in the turret. The tool-holder, or tool-carrying sleeve, is prevented from rotation by a fork within which it slides, extending from the turret through the casting.

The rings, after boring and turning, are cut off by reversing the tool block and presenting a gang parting tool to the work, in conjunction with a freely rotating eccentric support carried in the turret.

The thickness of the rings, as now roughed out, is 1-32 inch greater than the width of the groove in the piston, and the next operation is to true the ring on an arbor and square down the sides to the finished thickness. This is done in an engine lathe upon the fixture shown in Fig. 1, which is held in the spindle, leaving the outer end without support. The inside of the ring bears at *a a*, the periphery of an expanding collar with a number of alternate slits cut in deep from each edge and adjustable at each side by the screwed flanges *B B*.

The tool used is shown in Fig. 2 and consists essentially of a hinged truing plate and opposite adjustable cutters. The cutters are formed and are ground on the top only, and by loosening the screw *A* may be adjusted by the screws *B B* forcing the cutters along the taper seats.

The truing plate has broadly rounded corners and, thrown down in the position shown, is forced in against the work, truing it upon the arbor and centralizing the work with the cutters. The plate is then swung upward on its pivot out of the way and the sides of the ring are faced by the tool.

The ring is now placed in a vertical position on a miller in the jig shown in

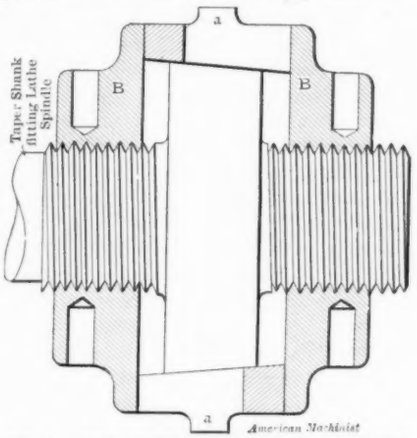


FIG. 1. EXPANDING ARBOR FOR FACING PISTON RINGS.

Fig. 3, with the thinnest part of the ring upward and the table is slowly raised, carrying the ring past the two end mills, driven in the fixture shown in Fig. 6. It is required to mill from each side of the ring to the center, in such a manner that the ring will be cut through at one point and such stock removed from the sides that, when the ring is pressed together, one of the severed ends will touch and there will be an opening of ¼ inch at the

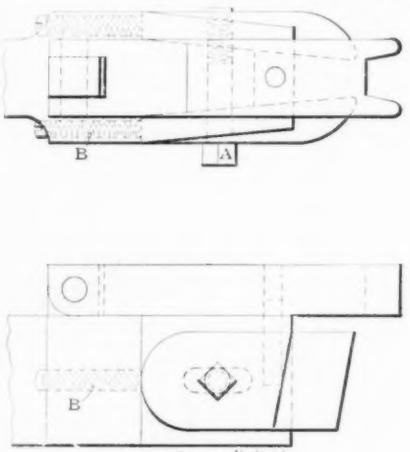


FIG. 2. ADJUSTABLE TOOL FOR FACING PISTON RINGS TO WIDTH.

other, thus providing space for the locating pin in the ring groove of the piston. It will be observed that the end mills are of different diameters and, while on the same center line horizontally, are placed out of line with each other so that their opposite corners run as close as possible together to produce this result.

After milling, if the ends of the rings are pressed together, as they will be when

in the cylinder, it is evident that the ring will assume an ovoid shape, and it must, therefore, be pressed together and the outside ground to the diameter of the cylinder.

In rough turning, in the turret lathe, we left the diameter .175 inch larger than the finished cylinder, and when after milling we spring the ends together a half an inch, we have used up .159 inch of this

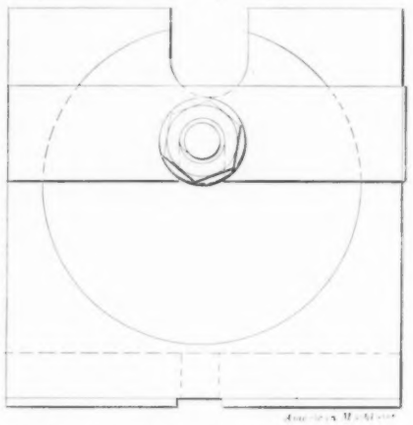


FIG. 3. FIXTURE FOR HOLDING RINGS FOR MILLING.

surplus diameter, leaving us about .016 inch allowance for grinding.

The fixture shown in section in Fig. 4 is mounted in the grinder spindle. The knurled collar *A* which is free to slide upon the support, is slid out over the ring, closing the ends together and approximately truing the ring. With the collar still over the ring, the washer is clamped against it, forcing it against the seat *C* and rigidly securing it. The collar is then pushed back and the ring is ground to the diameter of the cylinder.

Ordinarily, this method produces a sufficiently satisfactory ring, but it is evident that the action of the collar will be to make the ring approximate a circle, or to spring it in from its ovoid shape. A better ring

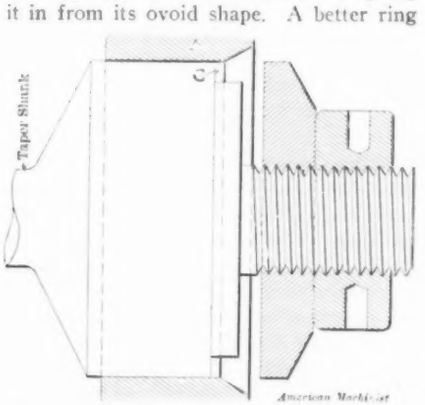


FIG. 4. CHUCK FOR FINISHING OUTSIDE OF SPRUNG RING.

is produced by cutting away portions of the collar *A*, so that it will act only upon the sides at right angles to the split, and preserve the ovoid shape. This grinds more from the free ends and the ring approaches a true circle more perfectly when released.

The St. Louis Exposition Ready for Exhibits

Those who intend to exhibit at St. Louis have an opportunity such as has rarely, if ever, been realized at any previous exhibition, to be in place and ready at the opening and to get the full advantage of all the days of the exhibition. The following letter sent out by Mr. F. J. V. Skiff, director of the division of exhibits of the Louisiana Purchase Exposition, should be immediately heeded and acted upon by those interested:

"The exhibit palaces of the Louisiana Purchase Exposition are now all practically completed. Exhibitors can now obtain possession of their spaces. This condition obtains at a much earlier period than in any previous great exposition. Should there be any incompleteness on May 1, when the exposition is opened, it will be due to the delay of exhibitors. No exhibitor ever regretted having installed his exhibit too soon. The man who is ready is always envied by those who are 'waiting for their exhibits to arrive.'

"At the present time the railway companies are able to handle shipments with reasonable promptness. As the date for opening approaches, experience shows that there will be congestion at freight terminals. This congestion is not only very annoying, but it is very expensive to the exhibitors. To have a representative or a force of men at the fair awaiting day after day or week after week for exhibits to arrive costs a great deal of money. Every consideration, therefore—the interest of the exposition, fairness to the public and the economy of expenditures on the part of the exhibitor—favors early shipment of exhibits and getting them on the exhibit space as soon as possible. It is evident that the unfinished condition at the opening, if it occurs, will be properly blamed neither to the exposition company nor to the railway companies, but to the exhibitors themselves."

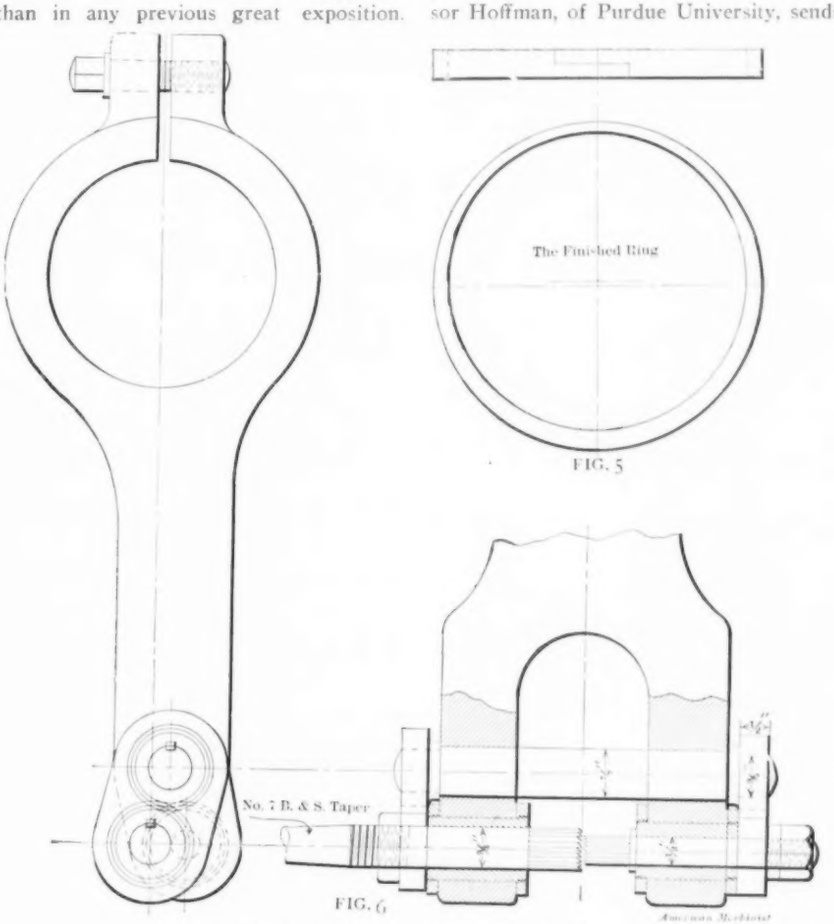


FIG. 6. RIG FOR MILLING NOTCHES IN RINGS.

FIG. 5

Machine Design at Purdue University.

Referring to the articles by Mr. Herzberg and Mr. Raeburn on the design of punching and shearing machines, Professor Hoffman, of Purdue University, sends us some mimeographed sheets on the same subject which are given to his students in machine design. The sheets cover the entire design of the machine and form one of the best examples of instruction in machine design that we have seen. Such a machine furnishes perhaps as good an example as could be chosen of the application of definite principles to a definite purpose, and the example is utilized in an admirable manner.

Talk about standard sizes for catalogs! We have recently received one 15½x7 inches, opening lengthwise. If anybody should wish to preserve it for reference where would he put it?

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Untaxed Alcohol for Use in the Arts.

We are glad to learn that a renewed attempt is being made to remove the internal revenue taxes from alcohol when denaturized and thus rendered unfit for human consumption, though still unimpaired for use in the arts. To this end a bill has been introduced in Congress and a committee of manufacturers has been formed to influence public opinion and assist the passage of the bill.

The policy which it is proposed that this country should adopt has been in force in Germany for many years, and it is largely due to it that German chemical industries have risen to their present commanding position. In one instance at least (the manufacture of fulminate of mercury) the prevailing tax rate on alcohol has killed an industry in this country and transferred it to Canada, where practically all the fulminate used in this country is manufactured. The consumption of denaturized alcohol in Germany has grown to an extent which in twenty years has raised that country from small beginnings to the position of the largest alcohol producer in the world.

It is not, however, in chemical industries alone that cheap alcohol is important. The constantly rising price of gasoline is well known to be the most ominous thing that confronts the automobile industry in this country. Alcohol furnishes a substitute and alcohol driven automobiles have been largely developed in Germany. Because of this phase of the matter, we shall no doubt see, or at any rate feel, the fine hand of the Standard Oil Company in opposing this measure.

Alcohol is also used to a considerable extent in Germany as fuel for auxiliary house-warming apparatus and for cooking ranges, very much as gas stoves and grates are used in this country, and with the obvious advantage that alcohol is available in the country and in villages having no gas works. In addition to this, an entire line of lamps and chandeliers in which alcohol is used in combination with a Welsbach mantle has been developed and has come into wide use in Germany.

All these things indicate the large development of alcohol-using apparatus and machinery which await the removal of the tax. Inasmuch as alcohol is made from grain, the cheapest of all natural sources for it being corn, which, practically speaking, is grown only in this country, the matter is of immediate and large interest to the farmers as well as to manufacturers. It is estimated that the removal of the tax would so increase the consumption of alcohol as to provide an additional market for 50,000,000 bushels of corn per annum. In Germany alcohol for industrial purpo es is made from potatoes which, though inferior to corn, form the cheapest source of supply there available.

There is probably no measure before Congress of more far-reaching importance to manufacturers and farmers, as well as to the public at large, than this. It involves the surrender of no appreciable revenue to the government, as the present tax practically prohibits the use of alcohol in the arts, and there is no interest to be adversely affected by it except those of the Standard Oil Company. We shall see what we shall see.

Co-operation for Mutual Advantage.

While the letter ballot is being taken by the American Society of Civil Engineers to determine whether it as a body shall participate in the proposed beneficence of Andrew Carnegie in building for that society a house as perfectly adapted to its needs and to the special individual needs of each of the other engineering societies as human wisdom can devise and modern skill and modern facilities can construct of modern materials, there is probably nothing which we can say that will in the least influence the result. Nevertheless, we are intensely interested in that result, as we believe the appreciation and acceptance of a unique and magnificent opportunity is involved. Mr. Carnegie is indebted as is perhaps no other living man to the engineering profession, and it was a natural thing, and an eminently proper thing, notwithstanding that it was also an example of munificence which stands alone, for him to make the proposition which he has made to provide out of his wealth a suitable house for each society to live in, to exercise therein its every function most freely and fully, and to grow therein most lustily. Mr. Carnegie's proposition was a very simple one. It was to provide for each society precisely what its own wisdom and the knowledge of its own needs and prospects should determine; only this and nothing more. In the carrying out of this purpose common sense could not well be ignored. No one could fail to recognize that it would be economically advantageous for each of the societies to have the use in common of those conveniences which each could use only occasionally and intermittently. The cost of one building and the expense of maintaining and operating one building must evidently be less than that of maintaining and operating a half a dozen separate buildings, more or less, and at the same time each of the societies could have enlarged privileges and be vastly better served in every detail in the one building. This must be conceded and does not admit of discussion. If the single Union Engineering Building should be at the same time a magnificent thing which both the donor and the users thereof could regard with pride and satisfaction, it would be creditable and gratifying to the human nature of all concerned. Precisely the advantages in common which the union building offers are realized in the modern office building and in the large apartment house. In the former are often housed the keenest competitors in business, and yet no one has ever discovered a shadow of disadvantage in such contiguity.

In the apartment house the separate families live in their several ways in absolute independence of each other, and, if they choose, in absolute ignorance of each other's doings and comings and goings. Such independence is the thing contemplated in the union engineering building, and it is impossible for us to understand that the engineering societies individually or collectively are different from mankind in general. If we could imagine a suitable building already in existence, with all the office facilities and library and meeting rooms precisely as required, with light and heat and elevator service and all the other needs provided, and if it should come in the way of two or more societies of somewhat similar or allied interests to need to hire accommodations in such a building it could not be imagined that one would refuse to become a tenant because the other was there. It is still less easy to understand why any society could take such a position, when the question is not one of hiring accommodations but of accepting them as a gift under such conditions as would be to the honor of both giver and receiver. To accept and to hold and manage the building proposed as a free gift it is necessary that representatives of each of the societies which unite in accepting it shall be sufficiently organized to enable them to act conjointly and with legal authority, and beyond this it is not necessary for the societies to come together. It is strange that any difficulty should have been made over a thing so simple. Engineers of all the societies individually co-operate continually to their mutual advantage, and the same advantage is offered in the co-operation of the several bodies with which the individuals are affiliated.

Equipment and Competence.

A certain British military expert, who has been quoted as commenting upon the naval operations conducted by the Japanese at Port Arthur, seems to have learned the same lesson that has been taught to many who have had to do with machine shops. Said he:

"Port Arthur proves absolutely nothing but the fact that modern science has outstripped the capacity of certain nations to make an intelligent use of the new weapons. It would have been precisely the same thing if it had been battleships and torpedoes, men-of-war and fire ships, or triremes and catapults. It was not an affair in which intelligence and expertness combatted similar qualities, but rather a case where skillful, courageous sailors took advantage of stupidity, negligence and incapacity. War is an art, and if the artist is not a master he will produce nothing that will live."

Whether this is a fair characterization of the Russian officers' conduct or not we do not pretend to say; we only draw attention to the fact that this same principle applies to machine shops and other manufacturing establishments. Too many men connected with them jump to the conclusion that because a shop has all the latest and best equipment and finest buildings it must therefore be successful. The fact is that, after all, much more depends upon men than upon tools and equipment, and no amount of money spent in equipment will overcome the handicap of incompetent management. The best men will of course always get the best possible equipment that circumstance will permit, but they will not stop there nor imagine that because they have it success is assured. There must still be the *man* behind the gun, and not only war but the conduct of manufacturing establishments is an art in which none but competent men can hope to succeed if the competition of others who are competent is to be met.

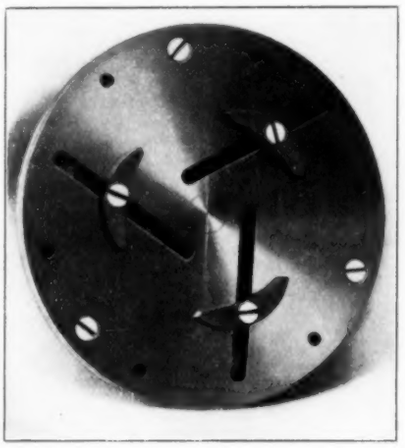
The Metric System Before Congress.

At the hearing of the House Committee on Coinage, Weights and Measures, held February 11, protests against the passage of the pending metric system bill were made by Mr. William Lodge and Mr. Jas. C. Hobart, of Cincinnati. Mr. Lodge appeared as vice-president of the National Machine Tool Builders' Association and Mr. Hobart as a delegate of the Manufacturers' Club of Cincinnati. Mr. Henry R. Towne, of New York, also appeared to complete the argument which was begun by him at the preceding hearing.

Some New Things.

PATTERNMAKER'S CHUCK.

This chuck is designed especially for patternmakers, and will center a circular piece of work instantly, as the front plate requires but part of a turn to open the jaws wide or to run them to the center.

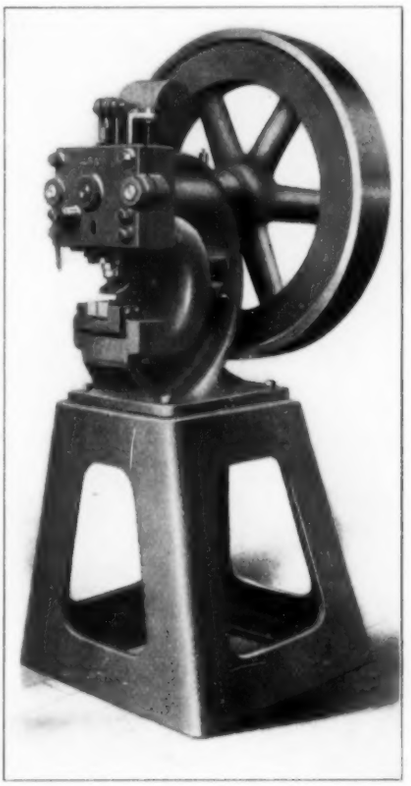


PATTERNMAKER'S CHUCK.

The chuck body has a hub threaded to fit the lathe spindle, and to its recessed face are pivoted three flat links or arms, the outer ends of which are connected to the jaws by screws passing through the slots in the thin front plate or cover. As the latter is turned (by means of a spanner) the jaws must of course move in or out, according to the direction in which the circular plate is rotated. The plate is kept in place on the chuck by three shoes fitting and sliding in a dovetail groove formed around the face and near the edge of the chuck body, these shoes being attached to the slotted disk by the three flat-head screws shown near the edge of the chuck. F. R. Inman, 170 Midway street, Providence, R. I., is the inventor.

PUNCHING MACHINE.

This solid frame punch is designed for use in small boiler shops, blacksmith shops and iron works. The flywheel and shaft run continuously, and by means of a gag



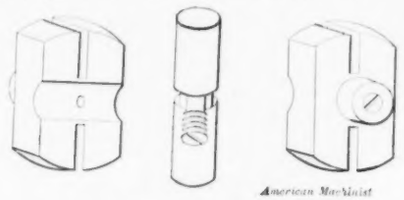
PUNCHING MACHINE.

which operates on the plunger only the latter is stopped at any stroke of the machine at the highest point in its travel. The gag is very quickly and easily operated by a small lever which is shown at the front of the cover plate and which throws out automatically, stopping the entire plunger. By this means the punch can be operated at a high speed without shock or jar. The punch-holder and die socket are adjustable, and the die block is so designed that all kinds of structural shapes, bars, plate, etc., may be punched. Shearing tools may be easily substituted for the punching attachment, and the cast-iron base on which the machine is mounted may be dispensed with and the punch mounted on a bench if preferred. The maximum punching capacity of this machine is $\frac{5}{8}$-inch holes through $\frac{3}{8}$-inch plate, or $\frac{1}{2}$-inch holes through $\frac{1}{2}$-inch plate. The speed is from 60 to 70 strokes

per minute. It is built by the Cleveland Punch & Shear Works Company, Cleveland, Ohio.

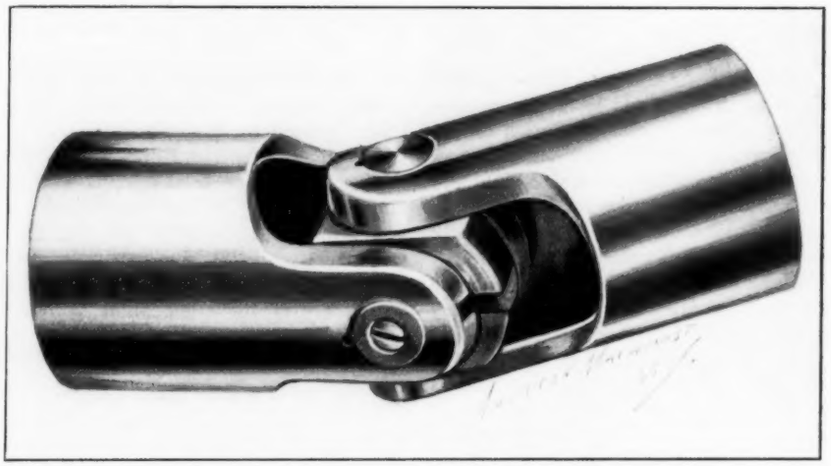
A SELF-OILING UNIVERSAL JOINT.

The essential features of this joint will be understood from the half-tone and the small cut of the parts in detail. The swivel block, it will be seen, is made in halves, each half having a trunnion fitting the hole in one side of the jaw, so that while but one cross-pin is used both of the rolling axes cross each other at the common center of the joint. Each half of the block has a portion of its flat inner face cut away so that the bearing for the cross-pin is less than a half-circle. To assemble the joint one of the half-blocks is first



DETAILS OF SELF-OILING BLOCK.

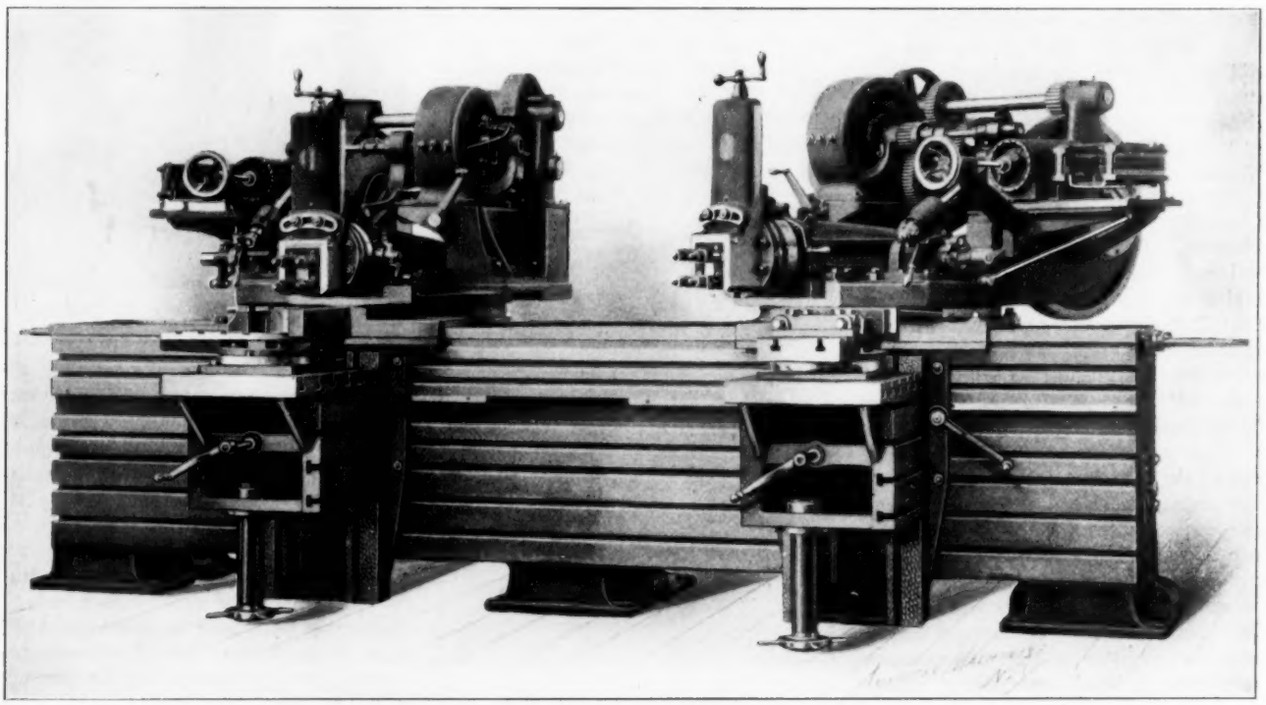
inserted with its trunnion thrust just through its hole in the side of the fork. The cutting away of the inner faces of the two half blocks thus provides sufficient space for the insertion of the second half block, and when it is in place with its trunnion coming flush through the other side of the jaw the space between the faces of the half blocks is filled with a porous, oil-resisting washer which provides the means for continuous lubrication. When the two half boxes are in place, the cross-pin can be inserted through the jaws of the other block. This pin, it will be seen, is provided with an oil hole and a screw plug in one end and with channels which provide for the distribution of the oil to all the working portions of the joint. The cross-pin is held in place by a small pin, not seen, in the edge of the jaw. The joint is the invention of F. E. Bocorselski, 384 North Main street, Springfield, Mass.



SELF-OILING UNIVERSAL JOINT.

DOUBLE HEAD TRAVERSE SHAPER WITH SWIVELING SADDLES.

This 24"x14' machine, designed for machining simultaneously the two ends of steel beams, or similar work, at angles of from 45 to 90 degrees, is unique inasmuch as it is, so far as is known, the first shaper built with the swiveling saddle feature. As shown in the half-tone, each head is driven by an individual motor which not only operates the ram, but all feeds as well; that is, the slow feed and the rapid traverse for the saddle, and the power feed for the head, which feed may be either vertical or at any desired angle. Further there is a hand traverse for the saddles through longitudinal screws, the ends of which are shown at the ends of the bed; and for the heads there are both vertical and rotary hand feeds. The longitudinal feeds, both slow-cutting and rapid traversing, are obtained through gearing operating nuts engaging the longitudinal screws, a system of bevel gears transmitting the motion from the swiveling saddle mechanism to the gearing in the traversing saddle below. The motors, which are Crocker-Wheeler, 5 horse-power machines arranged for the three-wire system, are carried with their controllers on brackets bolted directly to the saddles, the controllers, like the various

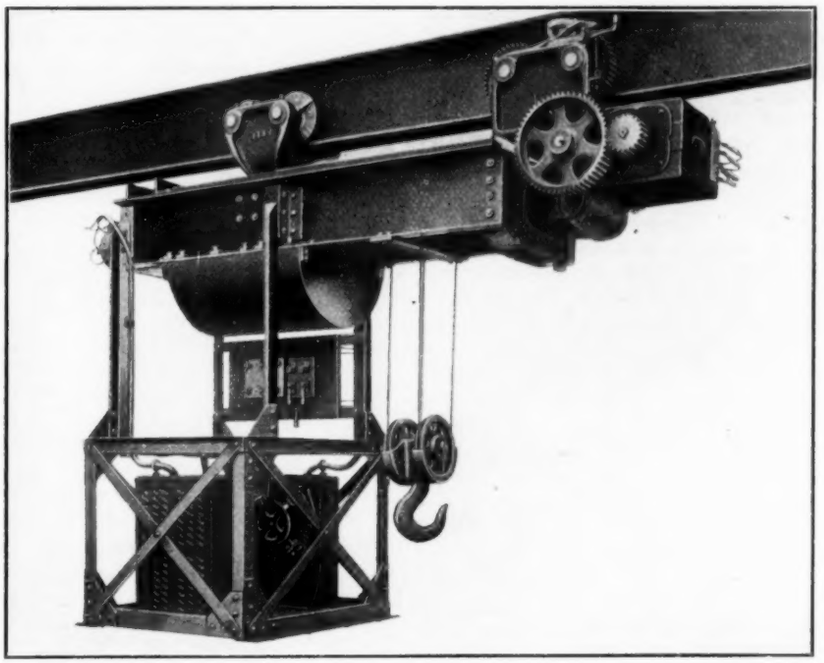


DOUBLE-HEAD TRAVERSE SHAPER WITH SWIVELING SADDLES.

feed levers and cranks, thus being always within convenient reach of the operator. The machine weighs 27,500 pounds and is built by the Cincinnati Shaper Company, Cincinnati, Ohio.

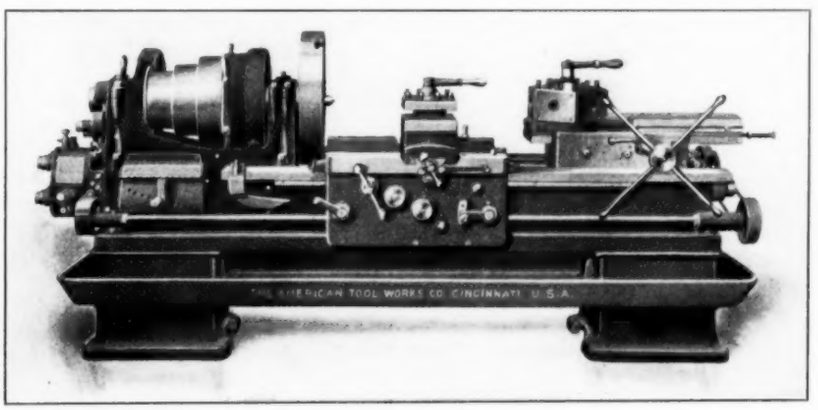
ELECTRIC TRAVELING HOIST.

The accompanying half-tone illustrates a recent product of the crane department of the Niles-Bement-Pond Company. The



ELECTRIC TRAVELING HOIST.

hoisting mechanism is placed between the channel framing of the trolley, is direct geared to the drum and is fitted with a standard load and motor brake. Power for hoisting is electric in all cases, but the trolley travel may be by either electric or hand power. The hoists are also arranged



FRICTION HEAD LATHE WITH TURRET.

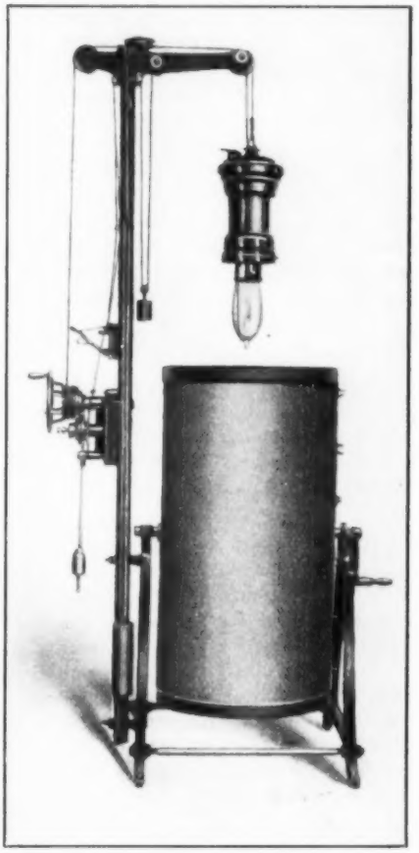
to be operated from the floor by pendant controllers, if so desired, and for use on curved tracks are fitted with swivel trucks. The hoist is made in three sizes of 3, 4 and 10 tons capacity, respectively.

FRICTION-HEAD LATHE WITH TURRET.

The friction back gears in the head of this lathe may be thrown into or out of service by means of the vertical lever in front, or for open-belt operations the back gears may be disengaged by a lever at the rear. The turret may be either round or of the hexagonal form illustrated, both types being made to suit the various sizes of lathes from 14 to 36 inches swing. The power feed for the turret is actuated from the regular feed rod through sprockets and chain. This gives to the turret the full range of the feeds obtainable through the rapid change gear mechanism shown at the head of the bed, a feature which has its obvious advantages. The worm is dropped out of mesh with the wheel by tripping mechanism readily controlled from the front of the machine. The turret slide can be connected, if so desired, with the carriage for positive lead when tapping. The swivel post has a conical bush, large end up, to take up wear and also prevent the turret from lifting should the binder be loose. The lathe can be furnished with a round or hexagon turret on the carriage instead of on the shears. In this case the turret is interchangeable with the compound rest, thus making it possible to use the machine either as an engine lathe or as a turret lathe. The turret on the carriage of course has power cross and longitudinal feeds, and through the screw-cutting mechanism a positive feed for tapping. American Tool Works Company, Cincinnati, Ohio, are the builders.

ELECTRIC BLUEPRINTING APPARATUS.

The accompanying half-tone illustrates a new electric blueprinting machine that is the product of the Johnson-Prentice Company, of Worcester, Mass. The machine is self-contained and the glass cylinder swings to a horizontal position for loading and unloading. The speed of the lamp through the cylinder is regulated by a pendulum and escapement, and is varied by the use of change gears. At the end of its downward travel the lamp is automatically extinguished.



ELECTRIC BLUEPRINTING MACHINE.

Technical Publications.

"Steam Boilers, Their Theory and Design." By H. de B. Parsons. 375 6x9-inch pages, with 155 illustrations. Longmans, Green & Co., New York, London and Bombay. Price, $4.00.

This is essentially a descriptive book, although the descriptive matter extends to details and includes formulas and rules for design. It is an excellent résumé of

its subject in reasonable compass and without padding and, as such, forms an excellent text book for engineering schools, for which purpose its fitness is increased by the inclusion of such subjects as chimneys, mechanical stokers, artificial draft, incrustation, corrosion and smoke prevention. Its mathematics is of the mildest order and the general reader will find nothing of this kind to embarrass him.

"Practical Kites and Aeroplanes." By Frederick Walker. 78 5x7-inch pages with 43 illustrations. Guilbert Pitman, London. Price, 1s. 6d.

This book is really a condensed scientific treatise on the modern kite, the word scientific being used to indicate that the instructions given are not based on rules of thumb but on ascertained facts and data regarding the proportions and lifting power of kites. The first or practice kites described are made with bamboo frames, but the author soon discards these and adopts steel tubing. The later kites described are capable of lifting a man, and personal ascents by them are contemplated. Of these the author naively says: "Like many other feats, a certain command of nerve power is indispensable." While the book will be found of interest to all who are interested in kites, few, we fancy, will push their enthusiasm to the point contemplated by the author.

"Ornamental Turning, Volume I." By J. H. Evans. 165 5x7-inch pages, with numerous illustrations and folded plates. Guilbert Pitman, London. Price, 3s. 6d.

We have often referred to the zeal with which amateur mechanical work is followed in England and to the high-class lathes and other tools which are made for the use of amateurs. The book under notice is intended for the use of amateurs and is far superior to the generality of books of this class, at least as published here. It not only shows things to be made, but shows how to make them, while its illustrations of the attachments which are provided for English amateur lathes will be a revelation to those whose acquaintance with such things is limited to those made here. We doff our hat to the English amateur mechanic, who is found in all the walks of life (a leading member of the craft who is referred to in this book being a clergyman), who maintains industries for the supply of his wants, as well as a not inconsiderable literature both in periodical and in permanent form, and who shows the best sense in the selection of his recreations of any man we know.

A notable centenary slipped by last week with but slight notice; it was that of the first operation of a locomotive propelled by steam on a rail track. The record of the original and epoch-making event is clear. On Monday, February 13, 1804, Richard Trevithick, a Cornishman, made the first trial run with a locomotive built by himself on a then private tram road from Merthyr Tydfil to the Glamorgan Canal, the course being now a part of the Taff Vale Railroad. The engine weighed 5 tons, the grades were steep and the track we can understand was crude, but the trip was a complete success, a public exhibition trip being made a week later. Trevithick died poor while he helped to make the world rich. Descendants of his are today mechanical engineers in charge of motive power in Japan and in Egypt.

The appalling fire which recently swept a large part of Baltimore makes much work for the salvage companies, who salvage goods damaged by fire and sell them for the benefit of the fire insurance companies. The goods damaged must be carefully dried before they become salable, much depending upon the success of this drying. The Underwriters Salvage Company, of New York city, recently placed an order with the B. F. Sturtevant Company for the complete equipment of a kiln for drying such goods. The kiln is divided into small rooms of various widths served by overhead tracks from which are suspended frames for supporting two tiers of baskets for the reception of the water-soaked material. These rooms are of fireproof construction and the size is governed by the material to be dried. Hot air is diffused through the rooms while the amount of air and its temperature are easily controlled. The drying is positive, economical and always independent of the weather.

The Sprague Electric Company announces that its Baltimore office, which was destroyed in the recent fire, is now located in the Maryland National Bank Building.

As a result of the Baltimore fire, the district office of the Westinghouse Electric & Manufacturing Company has taken temporary quarters at 221 North Calvert street, Baltimore.

For convenience of their numerous customers Gay & Ward, Inc., Athol, Mass., are now carrying a full stock of milling and gear cutters at 17 Warren street, New York city, Carlisle & Van Gelder having it in charge.

The Perkins Machine Company, Boston, Mass., the manufacturers of power presses, state that their business is very good, especially from foreign countries, they having received recently an order for twenty-one presses from Germany.

Inquiry for Machinery.

(172) We have an inquiry for a machine for grinding iron turnings. These ground turnings are used in the making of electrotypes.

Personal.

At the annual meeting of the Hartford Steam Boiler Inspection & Insurance Company, Francis B. Allen was elected first vice-president to succeed the late General Franklin. Mr. Allen has been second vice-president of the company nineteen years. The directors did not fill the place of president, vacant through the death of J. M. Allen, nor that of second vice-president.

Putnam A. Bates, assistant secretary and sales manager of the Crocker-Wheeler Company, has resigned his position and will retire from that company March 1. Mr. Bates has formed a partnership with John Neilson, who was until recently assistant secretary and assistant treasurer of the New York & Stamford Electric Railway. Under the firm name of Bates & Neilson the partners will conduct a general practice of consulting electrical engineering, with offices in New York city.

Obituary.

John W. Little died in Philadelphia, February 10, seventy-three years old. He was born in Scotland and came to this country in his youth, served as an engineer in the United States Navy during the Civil War, was one of the survivors of the Samoan disaster, and was chief engineer at the League Island Navy Yard from 1895 to 1900, when he was retired.

John A. Roche, ex-mayor of Chicago, who died February 10, sixty years old, began life as a patternmaker, having learned the trade at Utica, N. Y., his native city. He went to Chicago in 1869, where he became a dealer in machinery, for many years representing J. A. Fay & Co., of Cincinnati. After his mayoralty he was vice-president of the Crane Elevator Company and later managing director of the Otis Elevator Company.

William T. Bate, of the firm of W. T. Bate & Son, Conshohocken, Pa., died February 10, eighty-five years old. Mr. Bate was a native of Cornwall, England, where his father was a blacksmith and boilermaker. He learned his father's trade and served some years with an eminent engineering firm in Cornwall, coming to this country in 1847, and working as a boilermaker in various shops in New Jersey, Connecticut and Maryland. In 1856 he took charge of the shops of the Norris Company at Norristown, Pa., and remained there until the works closed. He was for a time superintendent of the Warren Foundry, Phillipsburg, N. J. The boilermaking firm of W. T. Bate & Son was established in 1865, and grew into a general machine business. Mr. Bate was an excellent draftsman and a prolific inventor, principally in boiler specialties.

New Catalogs.

Buffalo Forge Company, Buffalo, N. Y. We have received from this company two attractive booklets dealing with Buffalo steel pressure blowers and Buffalo forced draft apparatus. Illustrated by photographs.

"Triplex Hoisting Hints" is the title of an unusually attractive booklet published by the Yale & Towne Manufacturing Company, New York. By a well-selected and a well-made series of reproduced photographs the booklet shows the practical application of triplex hoisting blocks to many services in many shops. This little piece of trade literature would seem to be as convincing in effect as it is small in size. 3½x6, pp. 15, paper, with neat cover design.

"Fifty-five Years at It" is the title of an attractive booklet sent out by Hammacher, Schlemmer & Co., 209 Bowery, New York. Its object is to post the general public on the large range of goods handled by this company and the many catalogs published by Hammacher, Schlemmer & Co. in which these goods are listed. It gives a list of these different catalogs, outlining the lines included in each, and it tells how these catalogs may be obtained. 4½x7½, pp. 14, paper.

Hoshor-Platt Company, 120 Liberty street, New York. Industrial railways, showing locomotives, steam and electric; cars, supplies, etc., for many purposes. Valuable information is given relative to the laying of track, placing of switches and the best location for industrial railways for different services. One section of the catalog is devoted to coal-handling machinery made by this company. The catalog is well illustrated throughout with drawings and photographs. 8x10½, pp. 83, paper.

Hyatt Roller Bearings Company, Harrison, N. J. Bulletin No. 20, second edition: "Hyatt Flexible Roller as Applied to Heavy Duty at Slow Speed." The design and construction of the bearings are well illustrated by drawings, while their practical applications to services indicated by the title, such as car wheels, cranes, foundry wagons, shop cars, industrial railways, trolleys, hoist drums, etc., are shown by representative photographs. A special section of the catalog is devoted to the design of these bearings. 6½x8, pp. 63, paper.

Brown & Sharpe Manufacturing Company, Providence, R. I. "Mechanical Machinists' Tools," including steel rules, straight-edges, squares, protractors, calipers, micrometer calipers and depth gages, gages, etc., with price lists. Profusely illustrated. 6x9, pp. 153, paper. A colored insert in catalog gives a list of new tools which have been added during the past year. These include new styles and sizes of combination squares, protractors, combination sets, firm joint calipers, etc., etc. Special attention is called to the new clamping device for micrometer calipers, which is much superior to the old style clamp nut.

New Corporations.

Condit Electrical Manufacturing Company. Directors: S. B. Condit, Jr., Somerville, Mass, *et al.*

New York Improved Meter Company; capital, $100,000; all paid in. President, C. F. Haney, New York city; treasurer, Jos. Lush, Jr., New York city; clerk, F. A. Clarke, Portland, Me. Directors: As above and W. T. Drew, Portland.

Dossert & Co.—Principal office, New York city; objects, manufacture mechanical appliances; capital, $250,000. Incorporators and directors for the first year: John J. Dossert, F. Everhart, Jas. L. Holland, all New York city.

Voigt Metal Company—Principal office, 113 Market street, Camden, N. J.; objects, manufacture and deal in castings; capital, $100,000. Incorporators: James G. Foukes, Max M. Robinson, Charles F. Voigt.

William K. Toole Hardware Company—Principal office, Pawtucket, R. I.; objects, buying and selling hardware, mill and electrical supplies and kindred lines; capital, $25,000. Incorporators: William K. Toole, Philip J. Bowen and Jennie B. Greene, all of Pawtucket, R. I.

Bradley Railway Signal & Supply Company, Providence, R. I.; capital, $100,000; purposes, manufacturing, installing, buying and selling and dealing in electrical railway block signalling systems and dealing in metals, wire, electrical batteries, dynamos, generators, converters, switches, bells, lamps and supplies. Incorporators: Harold E. Bradley, Warwick; Eugene F. Bowen, Providence, and Stephen A. Wood, Providence.

Hutchison Acoustic Company—Principal office, New York city; objects, manufacture electrical apparatus; capital, $500,000. Incorporators: M. R. Hutchison, New Rochelle, N. Y.; Z. B. Babbitt, Washington, D. C.; K. M. Turner, New York city.

Harrigan Sectional Bearing Company; incorporated in Maine. President, F. L. Dutton, Augusta, Me.; treasurer, L. H. Tracy, Augusta; clerk, C. L. Andrews, Augusta. Directors as above and G. R. Hadlock, Augusta. A company of this name is also reported as incorporated in New York State, with principal office at Buffalo, N. Y., by Francis T. McDonald, Nelson S. Hallett, Ed. B. Collister, Buffalo.

Sherman-Brown-Clements Company—Principal office, New York city; objects, manufacture mill supplies; capital, $3,000. Incorporators and directors for the first year: R. B. Sherman, E. H. Clements, Brooklyn; C. W. Brown, New York city.

The Abbot-Gamble Company—Principal office, New York city; objects, general engineers and contractors; capital, $20,000. Incorporators and directors for the first year: F. W. Abbot, Wm. H. Lyons, Minnie G. Abbot, New York city.

W. S. Schuler Spring Company—Principal office, Amsterdam, N. Y.; objects, manufacture and deal in vehicles; capital, $100,000. Incorporators: Wm. S. Schuler, Wm. P. Bennett, Amsterdam; Tracy C. Becker, Buffalo.

Ansonia Motor Car Company—Principal office, New York city; objects, manufacture vehicles, carriages, etc.; capital, $10,000. Incorporators and directors for the first year: F. C. Armstrong, T. B. Townley, Elizabeth, N. J.; C. I. Scott, New York city.

Robert Grant Company—Principal office, New York city; objects, to deal in iron and steel; capital, $5,000. Incorporators: Robert Grant, J. D. Goodhart, C. E. Jelliffe, New York city.

Carlson Motor Vehicle Company—Principal office, Brooklyn, N. Y.; objects, manufacture automobiles; capital, $100,000. Incorporators: C. A. Carlson, Brooklyn; L. Sondheim, E. Sondheim, New York city.

U. S. Agency of the Michlin Tire Company—Principal office, New York city; objects, manufacture motors; capital, $30,000. Incorporators: N. W. Mason, J. N. Marshall, J. J. Ackerman, New York city.

Security Steel & Iron Company—Principal office, Troy, N. Y.; capital, $100,000. Incorporators: E. T. Brackett, Jas. L. Scott, Frank J. Quinn, all of Saratoga Springs, N. Y.

Consolidated Motor Company, Islip, Suffolk County, N. Y.; capital, $50,000. Directors: L. M. Palmer, H. U. Palmer and L. M. Palmer, Jr., Brooklyn.

New York Iron & Metal Company; capital, $40,000. Directors: A. A. Cantor, Dean Emery and T. L. Thomas, New York.

Harper Machinery Company, New York; capital, $1,000. Directors: Andrew Harper, J. Stork and A. R. Palmer, New York.

Essington Rotary Steam Expansion Engine Company—Principal office, New Jersey Corporation Guarantee & Trust Company Building, Camden, N. J.; objects, constructing and manufacturing engines, boilers, machinery, etc.; capital, $300,000. Incorporators: Henry C. Essington, James Irwin, Almon P. Wint, Washington W. Davis, all Camden, N. J.

Ohio Tube Company—Principal office, 1 Exchange Place, Jersey City, N. J.; objects, manufacture tubes; capital, $10,000. Incorporators: David E. Edwards, Cornelius E. Edwards, Frank H. Hall, all Jersey City, N. J.

Rotary Machine Company—Principal office, Wilmington, Del.; capital, $50,000. Incorporators: W. S. Hash, Red Stone, N. H.; L. R. Flock, Shelby, N. C.; C. J. T. Moon, Clover, Pa.

The Continental Metal Company—Principal office, Brooklyn, N. Y.; objects, manufacture metals for lining journal boxes, etc.; capital, $10,000. Incorporators and directors for the first year: S. Metcalf, B. F. Burger and Augusta Burger, all of Brooklyn, N. Y.

Jennings Shade Adjuster Company—Principal office, New York city; objects, manufacture window shades; capital, $100,000. Incorporators and directors for the first year: H. Van Emden, Brooklyn, N. Y.; G. W. J. Angell, New York city; Geo. R. Jennings, Brooklyn, N. Y.

Boston Engineering Agency, Inc., Boston; capital, $10,000; par value, $10. President, Charles K. Darling, Boston; treasurer, Nathaniel N. Jones; clerk, Annie E. Brown, of Newburyport.

The Automatic Powder Filling Machine Company, Providence, R. I.; objects, building, operating, buying, selling and leasing machinery, putting up and selling medicinal powders and other medicines, buying and selling real estate, manufacturing tin boxes and cans and printing; capital, $150,000; par value, $100. Incorporators: Arthur C. Almey, George H. Webb and Frederick W. Rhodes, all of Providence.

The Burt Manufacturing Company, of Akron, O., with $50,000 capital. This company will manufacture and deal in oil filters, engine shields and other utensils, implements and articles made of tin, sheet metal or other metals or materials. It is already well known to our readers.

The Canton (O.) Smelting Company; capital stock, $10,000; incorporated by Max Runder and others.

Unger Brothers—Principal office, 412 Halsey street, Newark, N. J.; objects, manufacture jewelry; capital, $60,000. Incorporators: Herman Unger, Eugene Unger *et al.*

Lake Erie Boiler Works, Buffalo, N. Y.; capital, $100,000. Directors: Johannah Hammond, M. F. Hammond and Richard Hammond, Buffalo.

Torrance Malleable Iron Company, Green Island, Albany County, N. Y.; capital, $30,000. Directors: Frederick U. Griesman, J. F. Calder and W. E. Wooltard, Albany; W. H. Hepinstall, Rensselaer.

Steam Economy Company, Port Henry, Essex County, N. Y.; machinery; capital, $100,000. Directors: J. R. Sherman, G. D. Sherman and Alonzo McDonald, Port Henry.

Plumbers and Steamfitters' Supply Company, Buffalo, N. Y.; capital, $75,000. Directors: J. P. Fell, A. K. Sage and G. A. Jeffrey, Buffalo.

American Corundum Company, New York city; minerals and ores; capital, $25,000. Directors: J. B. Burnet, New York; R. M. Page, Brooklyn, and G. W. Scott, Asbury Park, N. J.

The Oozer Manufacturing Company, machinery, Jersey City, N. J.; capital, $25,000. Incorporators: Myron A. Wolfson, Moses Wolfson and William E. Lawrence.

Robt. T. McMurray & Brother, Brooklyn, N. Y.—Objects, manufacturing structural iron and steel work; capital, $20,000. Incorporators: Robt. T. McMurray, Wm. H. McMurray, of Brooklyn, and another.

Jerome Potter Company; objects, making and dealing in machinery; president, J. C. Ward, Portland, Me.; treasurer and clerk, B. G. Ward, Portland, Me.

Dahlstrom Metallic Door Company, Jamestown, N. Y.; capital, $30,000. Directors: Charles Dahlstrom, N. A. Johnson and another.

Western Railway Signal Company, Camden, N. J.; capital, $60,000. Incorporators: John G. Bennett, Walter C. Beckworth, Philip Peter, Joseph H. Phillips and Josh. B. Chapman.

Syracuse Supply Company, of Syracuse, N. Y.; to deal in machinery, tools, etc.; capital, $200,000. Directors: John Heldmann, F. H. Bentley and another.

American Heating & Ventilating Company, Audubon, N. J.; objects, manufacturing, erecting and constructing heating apparatus; capital, $25,000. Incorporators: Henry Bender, H. D. Le Cato and Thos. D. Poole.

International Spinning Ring & Traveler Company. Directors: Geo. F. Gould, J. T. Fagan, B. M. Welch, Portland, Me.

Manufacturers.

E. E. Smathers will found a $100,000 iron working plant at Bradford, Pa.

The Enterprise Gas Company expects to erect a plant at Egg Harbor City, N. J.

A new lace mill is proposed at Wilkesbarre, Pa. W. A. Banfield is interested in the company.

The People's Water Company is forming at Crafton, Pa., with $100,000 capital stock, to build a plant.

A machine shop at Quarryville, Pa., owned by John Shields, a railroad contractor, has been damaged by fire.

A building at Hilton, N. Y., is to be utilized by E. M. Upton & Company for barrel manufacturing purposes.

The Genesee Fruit Company, Bouckville, N. Y., contemplates erecting a new barrel factory the present year.

The Pittsburg Cathedral Glass Company will, it is said, locate a plant valued at $250,000 in North Millville, N. J.

Preparations are being made by the Santa Fe for a twenty-stall roundhouse, shops and storehouse near Shawnee, Okla.

The Quisiana Art Work Shop, manufacturer of furniture, etc., Laporte, Ind., has let a contract for new factory buildings.

It is reported that much machinery and apparatus will be needed in enlarging the Graham Bros. distillery, Rockford, Ill.

The Monongah Glass Company has been chartered with a capitalization of $100,000, and will begin operations at Fairmont, W. Va.

Samuel Morris may build at Newark, O., a plant for the manufacture of an automatic car coupler, on which he has been granted a patent.

An effort is being made to establish a new electric light and power company in Anniston, Ala. The movement is headed by A. H. Quinn.

It is proposed to build a big electrical power-house at White Plains, N. Y., for the Harlem Railroad division of the New York Central.

A company, of which H. L. Clayton, of Central, S. C., is president, will build a cotton mill not far from that place and near Liberty.

The New England National Automatic Fire Alarm Company has been secured by the Board of Trade, Ossining, N. Y., to locate a plant there.

William Germeyer has rented a building at Carlisle, Pa., and will install furnaces and machinery for the manufacture of automatic steam valves.

The Wisconsin Foundry & Steel Works at Cedar Grove, Wis., has purchased an additional acre of land on which it will erect a molding room.

The Hobart Electric Manufacturing Company, Troy, O., has voted to increase its capital stock to $100,000, and proposes to build a factory addition.

The Northern Engineering Works, builders of electric and hand power cranes, of Detroit, Mich., have increased their capital stock to $150,000.

For the Meade Cornice Works, Philadelphia, Pa., a $35,000 building, one story, 300x70 feet, is to be built at Forty-fifth street and Woodland avenue, that city.

New erecting shops and a brass foundry of the Texas & Pacific Railway, at Marshall, Tex., have been burned. The machine shops were saved from destruction.

The New York Air Brake Company, Watertown, N. Y., has contracted for 25,000 square feet of bituminous concrete flooring for the brass foundry of its new plant.

The stockholders of the Slatington (Pa.) Textile Manufacturing Company are building a machine shop next to the silk mill, where they will make fine machinery.

The Citizens' Gas & Electric Company, Lorain, O., is planning for a new plant. We understand that this will supply electricity, but have no information as to gas.

The Tanner canning factory at Oakfield, N. Y., is now owned by A. J. Tanner and Winters & Prophet, the latter a Mt. Morris firm. It is proposed to enlarge the factory.

Poughkeepsie, N. Y., hopes to have a factory to make self-threading machine needles invented by James E. Lyttle. Perhaps the local Board of Trade will give further information.

Plans have been finished by the Philadelphia city engineers for a $125,000 power-house, lighting and heating plant for the new Municipal Hospital, at Second and Luzerne streets.

A cassava starch factory is proposed for Pensacola, Fla., by Dr. Horatio Keeler and A. H. Keeler, both of Chicago, president and secretary, respectively, of the Gulf States Refining Company.

The York Safe & Lock Company and York Chemical Works (the latter a manufacturer of fertilizers), York, Pa., have bought land between their plants, and it is thought that these will be enlarged.

Arrangements are being made to establish a spike mill at Anniston, Ala., to be called the Anniston Spike Mill. We understand that it has some connection with the Weller Rolling Mill & Forge Company.

Louis P. Katz, said to be a furniture manufacturer, of Milwaukee, Wis., was lately at the Baltimore Hotel at Kansas City, where he proposes to establish a new plant, the Milwaukee factory having been sold.

David L. Stivin is at the head of an enterprise to manufacture fruit packages at Grand Rapids, Mich. Another plant, to saw and shape the raw material, will be established at Newaygo. E. M. Averill, of Sparta, is the inventor.

The Hecker-Jones-Jewell Milling Company, Produce Exchange Building, New York city, will erect an eight-story building at Corlears and Water streets, on a plot 200x250 feet. It will have facilities for the storage of 500,000 bushels of grain.

A company with a capital of $10,000 has been organized by men of Dunlap, Ia., for the manufacture and sale of an adjustable stove pipe and thimble invented by Charles A. Overton. Dr. G. Hood is president of the ocmpany. Ground for a plant has been secured.

The Newport News (Va.) Shipbuilding & Dry Dock Company is said to contemplate the establishment of a plant for the manufacture of electrical machinery used in warship construction. The company recently experimented with a steel castings manufactory and has saved much delay in building ships by making its own castings.

Representatives of the Baltimore Chemical Engine Company, which is understood to have an address at Boston, Mass., have purchased a building at Franklin, Mass., and will manufacture chemical engines, fire extinguishers and hose trucks there, intending to employ 100 hands at the start, and increase this number fully 100 within the first year.

The Prouty Wire Company's property in Charlton City, Mass., has been deeded to William H. Bailey, of Boston, who was the broker in the transaction. A corporation will be formed of practical wire makers, who will enlarge and improve the property and operate it in the manufacture of fine steel wire for card purposes. The property includes water-power.

Plans have been made for a new brewery for the Springbrook Brewing Company, of Adrian, Mich., to include 25-ton ice machine, engine and boiler plant, etc.; also for a new brew-house, cellars, etc., for the Belmont Brewing Company, of Martin's Ferry, O., including elevators, steam engine and electric plant, the cellars to be fitted out with steel cooperage.

The Nernst Lamp Company, in accordance with its new policy of establishing district offices in the large cities, has recently opened an office at 47 State street, Detroit, Mich., and appointed Charles F. Case district sales manager of the same. The territory embraced by this office is the lower peninsula of the State of Michigan, the northwestern part of Ohio and the northeastern part of Indiana.

The National Emery Wheel Company has just moved from Waltham, Mass., into its new works at the corner of Winona and Nebraska streets, Worcester, Mass. It has increased its capital, and Geo. F. Reif is president and general manager; Herbert B. Belcher, treasurer, and H. F. Sanderson, superintendent. This new plant is triple the capacity of its old one, and is located on the Boston & Albany tracks, near the station.

The "National Steel Company" is reported to have received a permit to build a large addition to its plant at Fair Haven (New Haven), Conn. The new structure will be a foundry, and will involve the expenditure of about $50,000. The plans call for a building 165x410 feet. It will be erected in three sections, with the furnaces in the middle section and two traveling cranes on either side. There seems to be a slight ambiguity in the expression of the company's name.

Dodge & Day, Nicetown, Philadelphia, Pa., are installing in the power-house of the Link-Belt Engineering Company, Philadelphia, Pa., a 340 horse-power Buckeye vertical cross-compound engine, direct connected to two General Electric 100-kilowatt, continuous-current, compound-wound generators. The boiler plant at the same establishment is also receiving attention, and while it may not be found necessary to increase the capacity, it is probable under-feed stokers will be introduced. The Taylor system of management is well under way at the Link-Belt works, and the results attained have been most gratifying.

Moving Picture Machines.

One evening in 1897 an American, temporarily located in London, was watching with considerable pleasure the last number of a music-hall program—a series of moving pictures projected by the Biograph. At sixty miles an hour the Empire State Express rushed toward him—and disappeared, leaving him amazed but uninjured. Again, in imagination he was flying across country in an English express and viewing from the car window the realistic flashing past of houses and hedges, trains and other familiar objects. Then came "Jumbo," the self-propelled engine of the Hartford Fire Department. As this old friend, spouting smoke and cinders, and accompanied by ladder trucks, hose carts and the ever-interested crowd of men and boys, rushed up Main street and, in the wake of the fire chief's buggy, swung down Windsor avenue, a somewhat homesick American made his way to Piccadilly, and thence homeward to his London quarters.

Such was my first introduction to the Biograph, though this machine had for some time been in service. At about the same period was made the acquaintance also of the Mutoscope, together with the discovery that, for the insignificant sum of one penny, properly deposited in a slot, one acquired the privilege of viewing an animated and wholly life-like representation of any one of a considerable variety of subjects. Like certain other devices originally intended for entertainment purposes solely, these moving-picture machines have gradually entered various fields of usefulness, until to-day the furnishing of amusement to an appreciative public is but one of a number of lines along which the activities of the American Mutoscope & Biograph Company, of New York, are being directed. And in one of these later developments in the moving-picture line the readers of the AMERICAN MACHINIST should be especially interested.

Although for some time certain mechanical appliances in motion have been photographed and then reproduced before the eye with every movement faithfully represented, it is not generally known that the movements of practically any piece of machinery may be recorded and reproduced in the same manner. Nevertheless, this is entirely practicable, and it is possible to-day for a builder of machine tools or other apparatus to exhibit to interested parties, at their own headquarters, the appearance of any of his machines in actual operation. This is accomplished through the medium of a portable Mutoscope resembling in form a fair sized camera and as easily carried as is an ordinary grip. This portable device is placed on the desk or table before the observer, who turns a crank at the front and views the running machine with the same facility that he might in one of the slot machines watch an ordinary series of moving pictures. The rapidity with which photographs for the picture machine are taken makes it absolutely essential that the operation be performed in sunlight or under brilliant artificial illumination. Naturally, therefore, the greater part of the mechanical apparatus displayed at present in these machines is of the class operated in the open air and consisting of ore conveyors, yard cranes, dredges, street sprinklers, etc. Still, quite a little shop machinery has been photographed while running, by the moving-picture camera, and the advent of the Cooper Hewitt lamp (as well as a new film recently

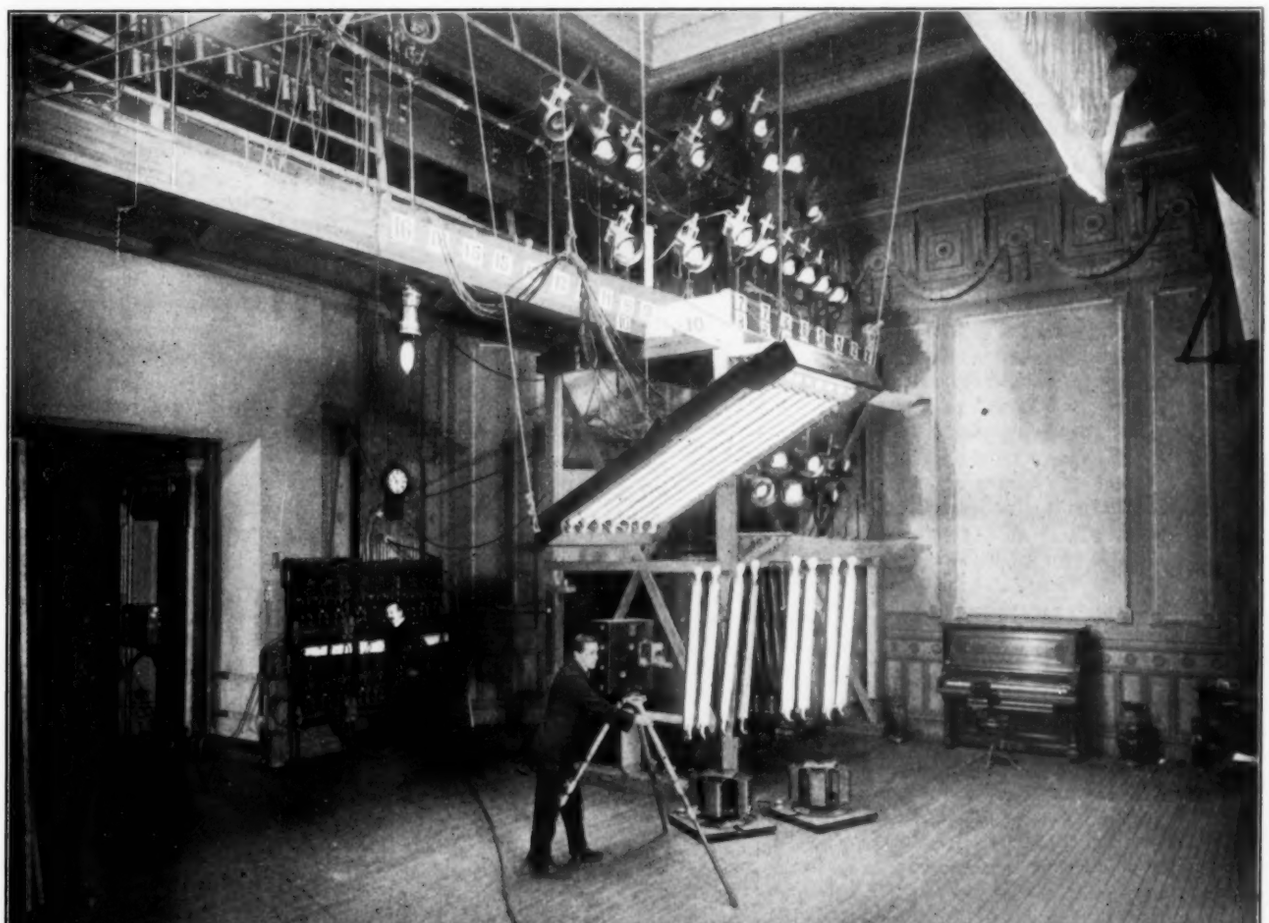


FIG. 1. THE BIOGRAPH STUDIO.

adopted for this work) has now rendered it possible to obtain an accurate and realistic record of the performance of almost any machine which is located in a shop provided with electrical equipment, as one or more of the mercury vapor tubes may be connected to the shop circuit to supply the greater portion of the required illumination.

These long glass tubes with their brilliant light have been found so valuable in this moving-picture photography that in the Biograph Studio on Fourteenth street, New York, no less than twenty-four such tubes—together with thirty-two specially designed arc lamps—are in service, the light available from the entire outfit being in the neighborhood of 300,000 candlepower. In addition to this magnificent lighting equipment, the studio is provided with all the paraphernalia of the modern stage, as here are acted and photographed all the indoor scenes reproduced by the Biograph and other moving-picture machines made by this concern. An excellent idea of the arrangement of the lighting apparatus is given in the half-tone, Fig. 1. The arc lamps are grouped as represented in the galleries, and may be lighted two by two, as required; each two being connected in series, and the switches below being duplicated in the gallery, so that an attendant at either point may control any lamp. These lamps are arranged for direct current of 50 amperes, at 55 volts, are adjustable in all directions, and are really searchlights, each having at the front an adjustable lens by which the rays may be directed as desired. Of the Cooper Hewitt tubes, eight are suspended in a tilting frame, while the others are mounted on three portable stands, so that they may be moved to any part of the room to throw light on the subject from any direction. With this combination of arc and mercury vapor lights each and every detail may be brought out as distinctly as the photographer desires.

It will be noticed that the camera in the center of the photograph is mounted on a tripod; while this is one of the cameras regularly used in the studio for photographing moving objects, it is, in actual operations, carried by a support giving it most sensitive and minute adjustments in every conceivable direction. This upright support is much like a drill column, and may be shifted to any point with little trouble. Besides the table for the camera it carries a support for a ¼ horse-power motor by which the camera mechanism is driven, the two machines being connected by a telescopic shaft equipped with universal joints. Two widths of films are regularly used for different classes of work. The narrow one, or the one from which the Mutoscope pictures are printed, is 1⅜ inches wide, and the pictures are enlarged to twice that width; the other film is generally employed for Biograph work, and as the detail must be very distinct in order that the picture, when projected, may be clear, the original film is made 2¾ inches in width, and no enlargement is made in the positive strip used in the Biograph. The wide film is friction fed through the camera by rolls and cams; the narrower strip is drawn along by a pair of sprockets whose teeth engage in perforations near either edge of the film. With either film the usual number of pictures taken per second is thirty—or 1,800 per minute, though in the case of machinery not moving at a particularly high rate of speed only fifteen exposures are made per second. Even this latter speed requires some pretty lively work on the part of the camera mechanism, but just consider what it means to start a strip of film, feed it from ¾ to 2 inches—according to its width—and stop it exactly at a certain point thirty times per second. This does not mean that the film has one-thirtieth of a second for each feeding movement; far from it. The rotary shutter running continuously at 1,800 turns per minute in front of the film has an opening which may be varied from a few degrees up to 40 per cent.; and with anything like the maximum opening the time during which the sensitive strip must be moved for each exposure is cut down to nearly one-half of the time required for the shutter to make one rotation, as the film must be brought to a dead stop before exposure and held stationary until again covered by the shutter. If one would appreciate the speed with which the camera performs its functions, let him examine carefully the series of photographs on the short section of film illustrated full width in Fig. 2. These show a Wellman-Seaver-Morgan ore conveyor in operation: though the car to the left of the center passes at a good rate of speed over the bridge-like structure, no difference in its location can be detected in any two consecutive pictures; in fact the total movement represented by the dozen views in the column is, as will be discovered, an exceedingly small one. The film boxes in the camera hold several hundred feet of

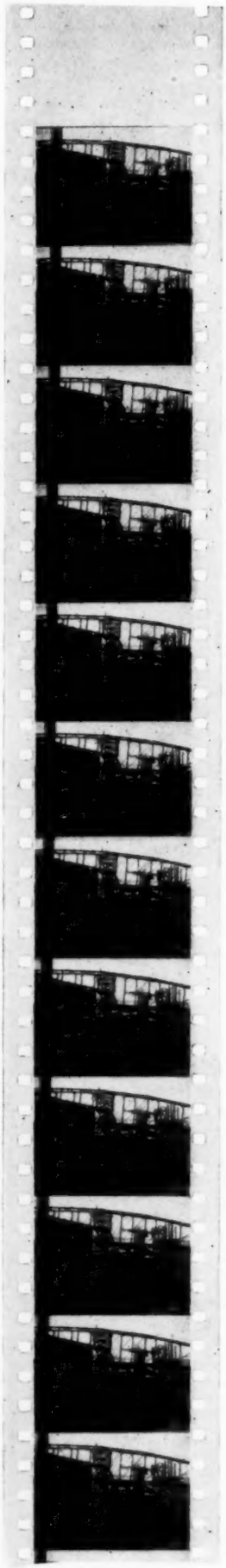


FIG. 2. PORTION OF ORE-CONVEYOR FILM.

FIG. 3. THE PICTURE REEL.

material, the blank strip as it is fed from one box and passes the lens, being accurately wound on a reel in another box below. And while the camera is not, as a rule, driven for more than a minute to catch a series of moving pictures, there have been occasions when the machine has run for a considerable length of time and used a goodly quantity of film in recording some important event. For example, when Messrs. Jeffries and Sharkey went down to Coney Island one evening in 1899 to settle a certain matter of importance, the moving-picture camera, which accompanied them and which was operated that night for the first time under artificial illumination, ran for an hour and forty minutes, and used between six and seven miles of film.

In reproducing pictures on a screen by means of the Biograph a positive strip printed directly from the negative is passed through the machine in practically the same manner as the original film is fed through the camera, a two-winged shutter which rotates constantly before the strip shutting off the light while each picture is fed opposite the lens, then exposing the picture for an instant, then hiding it while the film is fed to bring the next picture into register. The shutter being double rotates at but fifteen turns per second, although exposing thirty views in that time. But its speed is sufficient to prevent the eye from detecting any period when the film is obscured and the picture absent from the screen; and the observer therefore sees, apparently, instead of a series of views with blank intervals between, a single scene in motion.

For the Mutoscopes (the portable, the display and slot machines) and the Biogen, which is the power-driven four-lens machine used largely in store windows for advertising purposes, the photographs are arranged in reels and brought one after another into a vertical position before the eye. The reels are exactly alike in these different machines—and therefore interchangeable. The construction of the reel is shown in Fig. 3. It is about 10½ inches in diameter, 2¾ inches thick (the width of the print) and contains several hun'red photographic prints arranged in consecutive order with a piece of highly calendered playing card stock behind each print, the blank cards acting as springs to throw the picture cards one after another quickly by the lens as the reel is slowly rotated by worm and worm-wheel. Although the cards appear to be mounted radially in the reel, they are actually curved ahead from the center, steamed in this position in a form and then allowed to dry, the cards when so bent being much more springy than when radially disposed. As different reels get "tired" from long service, they may be placed in the form again and there reshaped for future service.

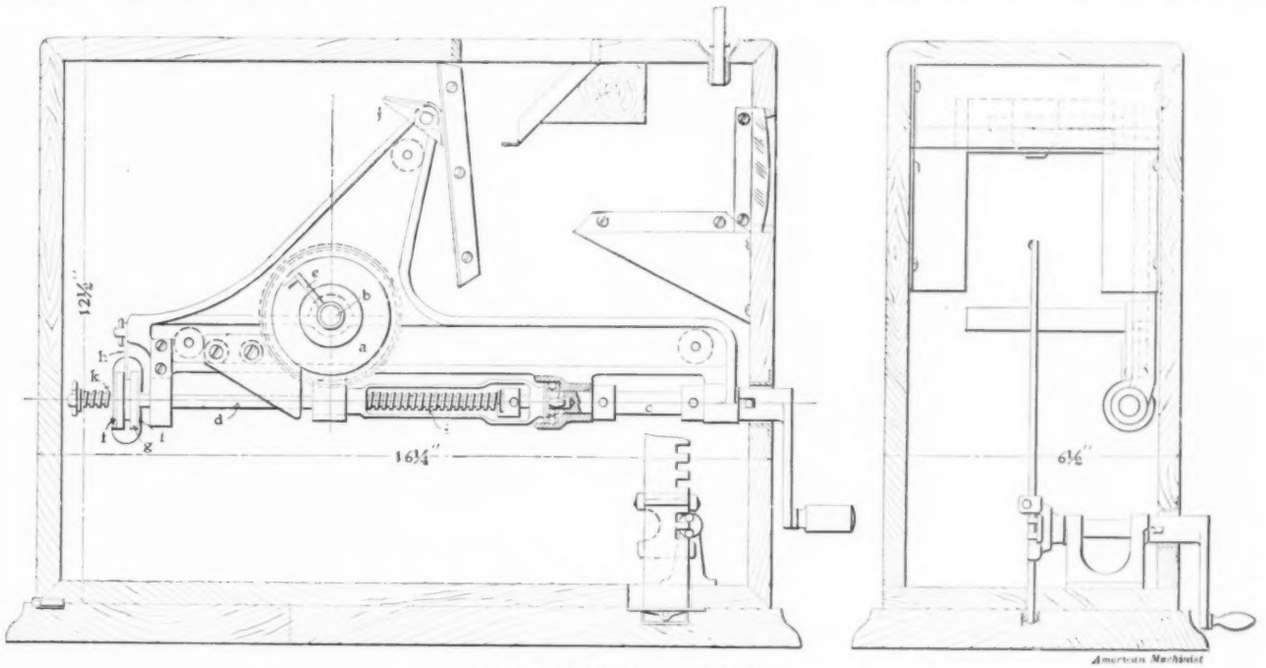


FIG. 4. PORTABLE MUTOSCOPE.

In Fig. 4 are given longitudinal and cross-sectional views of the small hand Mutoscope referred to earlier in this article. The mechanism for actuating the reel in this machine is of a very interesting nature, the worm-shaft operated by the crank handle immediately below the lens in the front of the case being so mounted that, when the crank is released the worm is automatically disengaged from the worm-wheel and the reel instead of being kept under tension is allowed to swing back (as in the larger machines) to normal position where it remains until the crank is again turned forward. Referring to the longitudinal section, it will be seen that worm-wheel *a*, shaft *b* for the reel, and shaft *c* which drives through universal joints the worm shaft *d*, are carried by a metal frame attached to the side wall of the case. At *e* is a lug which engages with a similar lug on the flange of the reel hub and causes the reel to rotate with the worm-wheel. At *f* are two friction plates which must turn with the worm shaft *d*, and between them is placed loosely on the shaft a friction disk *g* which is connected by a link to the lower end of a curved arm *h* hung on a pin at the top. The worm shaft passes freely through the worm and the semi-cylindrical shell formed integrally with the latter, and worm and shaft are coupled by a coiled spring *i*, one end of which is fastened in a collar on the shaft while the other end is attached to the hub of the worm. When the machine is standing idle, the worm shaft, instead of being in the position indicated with its worm engaged with the gear, is really dropped at the outer end, so that the worm clears the gear teeth, the disk *g* then resting slightly below the extreme end of hooked arm *h*. Now, when the reel is placed in position on axle *b* (the first print of the series of course resting against stop *j*) and the crank handle is operated, friction member *g* being held between plates *f* by spring *k* turns with the shaft and rolls up on its hook-shaped support, lifting the shaft *d* until the worm is brought into mesh with its gear, as represented in the drawing. And so long as the shaft is rotated to the right it will be held up firmly in this manner and the worm-wheel and reel will be turned ahead, one picture after another being brought up against the stop, pausing for an instant in a perpendicular position and then flashing by the lens in front to join the preceding pictures. As the reel is wound ahead there is more or less friction between worm and gear; and worm shaft and worm being connected, as mentioned,

by a coiled spring *i*, the worm naturally lags behind momentarily, winding up the spring until a pin in the shaft collar and a second pin in the worm shell come in contact, when the worm has a positive drive. The instant the crank handle is released the spring *i*, still under tension, throws the worm shaft to the left, and the friction disk *g* then rolls down and over the end of its supporting hook and drops the shaft, thus freeing the reel and allowing it to fly backward. And the result of all this is a device with which a man who ought to be the buyer of an improved machine of some kind and who it is hoped will be, can be shown at his own desk, what is very much like a view of the actual machine in operation.

F. A. S.

Hunting Old Furnaces in the Ramapo Mountains.

BY E. P. BUFFET.

There is a hardly a better way of spending a holiday than to go exploring in out-of-the-way country places. The pleasure of such an expedition, however, depends largely upon some definite object of quest.

FIG. 1. FURNACE AT SOUTHFIELDS.

As for myself, I have at intervals, for some years past, been studying up the early chronicles of iron manufacture in America—particularly in New Jersey and Southern New York—and visiting a few of the scenes of bygone industrial activity. To read in some historical volume about a forge or furnace, celebrated in Colonial days as a Homestead or Bethlehem; to identify on a map its obscure location; and then, over mountain or morass, to seek and find its mossy vestiges, is to me a fascinating amusement. About two years ago (see Vol. 25, page 409) I thus exploited Samuel Ogden's moonshine slitting mill at Old Boonton, N. J. The present article results from a pilgrimage on horseback, and others by train and buggy, in Orange county, N. Y.

The equestrian tour began with a steamboat voyage from New York to Haverstraw, on the Hudson, whence a morning start could be made directly across the Ramapo mountains. That range of hills, which reaches from New Jersey into New York, is by no means cloud-capped, but is characterized by exceeding wildness for a tract of country so near the metropolis. On the well-made road that saddles the ridges between Haverstraw and the Ramapo river at Southfields, some 14 miles away, one may travel for miles without a glimpse of cleared land and may observe through the open door of a wayside hut the primitive

FIG. 2. STERLING LAKE, LOOKING NORTH FROM NEAR FURNACE RUIN.

industry of basket-making. The Ramapo mountains, by the bye, have been reputed for a population of albinos, due to what cause I am unaware. Glacial boulders are strewn thickly over the region and severely tax the energies of a horse which, though indifferent to locomotives and trolley cars, regards it as a matter of conscience to shy at every roadside rock.

The gorge of the Ramapo river, followed by the Erie Railroad, is a region of great natural beauty and reminds one of the course of the Hudson among the Highlands. The stream itself is only a slender brook in the dry season, but in the flood of last fall it swelled over the ravine, carried away dam and bridges, and on its recession left houses strewn along its banks like match-boxes. At Sloatsburg a lake or reservoir broke through a hill, plowing a gulley, say, 20 feet deep by as many rods wide, dropping a thick deposit of sand and gravel on acres and acres of the plain below.

This territory was a lively one during the Revolutionary War, since it was on the line of march between the middle Hudson and the Jerseys. The valley is known to historical students as "The Clove." In passing it may be worth while to note

FIG. 3. FURNACE RUIN AND MODERN MINING PLANT AT STERLING FURNACE.

a legendary account of the curious origin of this name. On one occasion Washington and his army captured some stray sutlers' wagons of the enemy. Among the booty were several kegs of Jamaica spirits, to enjoy which in security the Patriots straightway betook themselves to the fastnesses of the Ramapo. In the midst of their festivities the Commander-in-Chief received an unexpected call from Mrs. Martha W. Never had a surprise by the enemy taken him more unawares, and he felt that his school-book reputation for sobriety of character would after all prove but a dream. Opportunely, however, Lafayette came to the rescue of his chieftain with a new spice of the Indies, a few grains of which he had brought over from Paris in his waistcoat pocket. Thus the day was saved, and in honor of the means thereof this place has ever been called "The Clove."

The rebel army repeatedly encamped hereabouts, and, if we could rely upon tradition, there would seem to have been some action, too, for at Augus-

FIG. 4. FRONT VIEW OF OLD FURNACE AT STERLING LAKE.

ta Falls, a few miles below Southfields, I learned of a trench into which, according to somebody's grandmother, soldiers' bodies had been thrown by the hundred. The district was infested with "cowboys" whose famous ringleader, Claudius Smith, was eventually captured on Long Island and hanged. An enormous boulder not far from Augusta Falls, which I take to be the one marked in an atlas "Man-of-War Rock," is shown as a favorite sentinel post.

Of late years this part of the country has, with excellent taste, been adopted by the wealth of New York city for the country club and residential colony at Tuxedo Park, which spreads over the mountains around the basin of what used to be called Duck Cedar pond.

Half a mile or so west of Southfields station, on the outlet stream of Mombasha, or Mount Basha lake, stands the ruinous furnace shown in Fig. 1, which will again be referred to. Returning to Southfields and following the river southward for a mile or more, we strike westward into the

hill country north of Tuxedo Park, toward Greenwood lake, but ere long turn again to the south and after a few miles through a territory of ancient iron mines reach the sequestered Sterling lake (Fig.

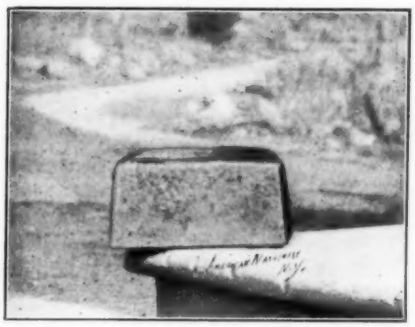


FIG. 5. OLD WEIGHT DUG UP AT STERLING FURNACE.

2) which lies in a mountain valley between the Tuxedo and Greenwood waters.

The country that does not belong to the Tuxedo Club is largely owned by the Sterling Iron and Railway Company, successor to the Townsends of early days. The company still has an active mining plant at the outlet of the lake (see Fig. 3). Sterling vies with its aristocratic neighbor in selectness, to judge by a placard in front of a grove by the roadside:

NOTICE.
THESE GROUNDS FOR ITALIANS ONLY.
NO ADMITTANCE.

It has often been pointed out that the "Dago" has his foot on an ascending social ladder, but I did not expect to see him so soon at the top of it. However, in spite of my inability to claim a drop of the blood of the Cæsars, I can testify to most courteous treatment by Mr. Benjamin Moffatt, Sr. (as I understand), whom I found in charge at the mine office, and by Mr. James Moffatt, on whom I called at the newer furnace three miles down the Sterling creek. The old stone stack illustrated in Figs. 3 and 4 has been standing, there is every reason to believe, for over 125 years. Near by was dug up the iron

FIG. 6. RUINS OF A NEWER STERLING FURNACE.

weight shown in Fig. 5. This is conjectured to have been used for weighing the output in early days, but such weights seem to have been a standard commercial product of the works.

From Sterling lake a winding wagon road follows Sterling creek and the Sterling Mountain railway to connect with the Erie below Sloatsburg, eight miles distant. Two or three miles from the big lake it passes a small one where stands the relatively modern Sterling furnace shown in Fig. 6. A side arch interior view of same is given in Fig. 7. The stumps of the piping, tuyeres or otherwise, are visible. A view from the hill back of the stack appears in Fig. 8. The roofless building in the middle ground was a blacksmith shop of no special significance, but near it is the site of a forge where, according to local tradition, was hammered out a part of the chain that was stretched across the Hudson at West Point in 1778. There is strong evidence for the assertion that this chain was wholly, or in the main, a product of the Sterling works. I have collected some interesting matter regarding it, but limitations of space forbid me to incorporate this in the present article.

A short distance below Sloatsburg is the village of Ramapo, N. Y., situated near "Ramapo Pass," which was fortified during the Revolution. This, however, is not to be confused with the New Jersey hamlet of Ramapo alluded to in histories

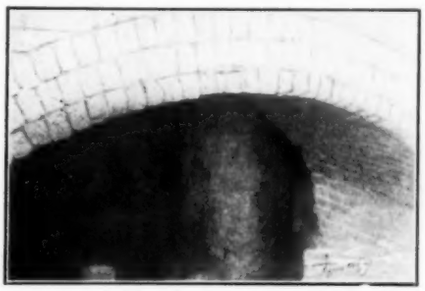


FIG. 7. TUYERE ARCH OF NEW FURNACE.

of the military campaigns, which lies several miles further south. Ramapo, N. Y., was founded in 1798 by Josiah G. Pierson & Bros. Ten years before, they had made cut nails in New York city with an imperfect machine, from material rolled and slit near Wilmington. At Ramapo they cut and headed nails by water power, using a machine patented by J. G. Pierson in 1795. They operated, in course of time, a rolling and slitting mill, forge, saw and grist mills, cotton factory, etc., employing hundreds of people. In 1820 the works rolled and slit 700 tons of iron and manufactured about 500 tons into nails. The Ramapo Manufacturing Company was incorporated in 1824 with $400,000 capital. The Ramapo Car Wheel Company now marks the location of the Pierson industries, and the Pierson family is still prominent in the town. The dam at Ramapo is shown in Fig. 9. A few days after the picture was taken this barrier was broken down by the flood, which washed away part of the village below.

The horseback pilgrimage proceeded *via* the lower valley of the Ramapo, which is chiefly a fertile, open country, close-walled on the west by a mountain ridge; thence continued east of Pompton, through Paterson and Passaic, to town, with no greater mishap than a "header," due to equine negligence and cadence.

FIG. 8. OUTLOOK FROM BEHIND NEW FURNACE.

Having now traversed the Ramapo territory in approximate geographical sequence, we shall in a subsequent article follow the course of its history.

The Age Limit.

This old age question keeps bobbing up in my mind and I am constantly asking: "How old does an engineer have to be to begin to retrograde; and by what methods does a thirty-year-old superintendent, who hardly knows the difference between the engine and the boiler, arrive at the conclusion that at the age of thirty-six or thereabouts an engineer begins to go down hill?"

If an engineer is content to see the wheels turn and the belts go, and looks for nothing further, it does not matter what his age is, he is too old for a new position; but for an engineer who keeps abreast with the times; one who to-day is studying the turbine and superheated steam, electrical transmission and concrete foundations—in fact, one who lets nothing that is new pass unnoticed and uncriticised; one who is ready to adopt new methods if better than old ones; will such a man ever

FIG. 9. DAM AT RAMAPO, N. Y.

get to be too old to be of the highest usefulness anywhere?

Suppose that George H. Corliss, Edwin Reynolds, Charles T. Porter and a host of others had been laid on the shelf at the advanced age of thirty-six by some high-

collared superintendent of twenty-five or thirty, whose chief qualification for the position was the number of his father's shares of stock in the concern. The Constitution of the United States fixes an age limit at which men may begin to serve their country in the halls of Congress, and curiously enough a man is old enough to become President just one year before he becomes too old to be employed as a clerk on some of our railway systems.—*F. L. Johnson, in Power.*

The Timmis Lithotype—I.

The remarkable inventions which we are about to describe are for the purpose of accomplishing machine letter press composition and printing, but by the process of lithography instead of typography. Inasmuch as the principle of the lithographic process is not generally understood, except by lithographers, it seems best to preface our description of the machines by an outline of that process.

In ordinary, or relief, printing the faces of the letters are raised above the surrounding surfaces, and the ink rollers in passing over the type deposit ink upon the raised surfaces, from which the impression is then taken. In intaglio or steel plate printing the faces of the letters are sunk below the surrounding surface, and these depressions being filled with ink while the surrounding surface is free of it, corresponding impressions are obtained. In lithographic printing the design or type matter is in neither relief nor intaglio, but is upon the same surface as the surrounding spaces, the inking of those portions of the surface from which it is desired to obtain an impression and the leaving of the remaining surfaces without ink being accomplished by using the well-known mutually repellant properties of grease and water.

Lithographic stone, with which until recently all lithographing has been done, is a light homogeneous yellow limestone of just sufficient density and porosity to allow water or grease to slightly penetrate its surface. This property is, however, almost duplicated by aluminum, and plates of this material are rapidly supplanting the stone. In addition to its lightness, its flexibility permits its use in rotary presses, whereas the stones can be used only on flat-bed presses. It is this fact which gave the first impulse toward the development of the lithotype. For anything except daily newspaper work printing from type or electrotype plates is also done on flat-bed presses, and it is the fact that the lithotype makes the rotary press available for book and magazine printing that is looked upon as one of its leading advantages. In addition to this there is nothing in the lithographic process to correspond with the electrotyping of the forms and the making ready of the press, which are inherent in printing by typography.

In preparing lithographic stones or aluminum plates the design or type matter is drawn or printed upon the surface by the greasy lithographic crayon or with lithographic ink, which is made of similar material in a viscous form. After the design is completed a dampened roller run over the surface will deposit moisture everywhere except upon the lines of the design, and an ink roller, following this, will deposit ink nowhere except upon the design, and from the stone or plate in this condition the impression can be taken as from a type form.

The above is an outline of the process by which all lithographs are made, and, inadequate as the foundation of the process may seem to the uninitiated, the designs so drawn upon the plate are in fact more durable than are relief engravings of corresponding fineness, as many as 150,000 impressions having been taken from aluminum plates without appreciable impairment of the design.

paper similar in appearance to a printers' galley proof. The matter is then transferred from this slip to the aluminum plate which goes to the press. Not only is this slip similar in appearance to the galley proof, but it is also used for the same purpose, corrections being made upon it in the same way. These corrections are incorporated in the form by resetting the defective lines upon another strip and attaching these lines in their proper places to the first strip by means of the adhesive property of the lithographic paper. This process may again seem inadequate to the uninformed reader, but it is the one universally used in other lithographic work. The proof slip may be marked up by the proofreader to any extent without affecting the plate provided he uses an ordinary lead pencil or ordinary ink, as these produce no effect upon the plate.

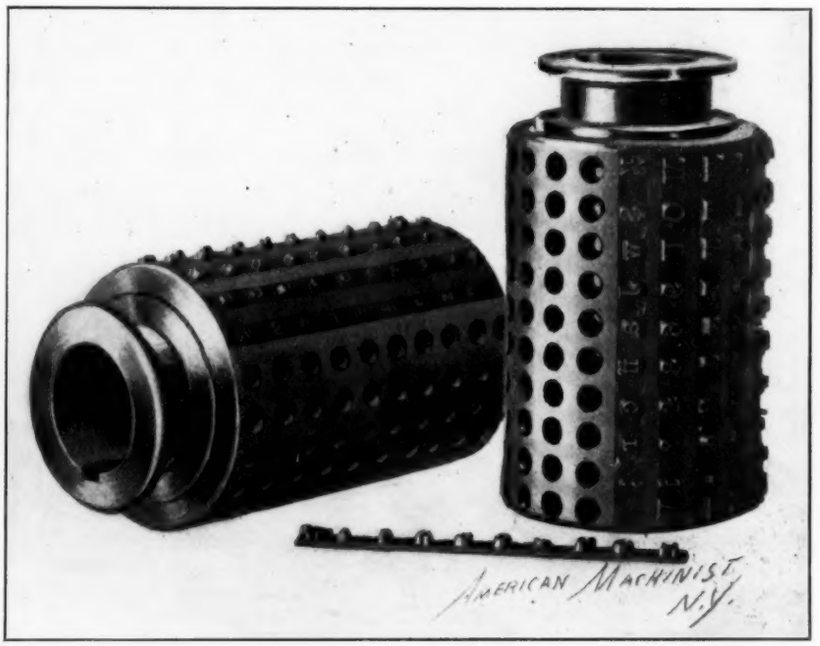


FIG. I. TYPE CYLINDER.

The description given relates to the fundamental principles of the process. In practice the repellant property of the wetted surface and the attractive property of the inked design are accentuated by suitable chemical treatment of the plate after the design is drawn or printed upon it, but into the details of this we need not enter.

The lithotype consists essentially of two machines. Of these the first is the composing machine, consisting of a key-board similar, broadly speaking, to that of a typewriter, and a perforating mechanism which punches a series of holes in a long strip of paper, the arrangement of these holes being different for each letter or other character. This strip of punched paper is then fed through the transfer printing machine which translates these holes into letters and prints the matter in lithographic ink upon a second strip of

Not only does the punched strip from the composing machines direct the second machine what letters and other characters it shall print, but it also directs it to provide the proper "justifying" or spacing between the words in order to completely fill the lines. In all composing machines the justifying of the lines has been the greatest of the problems to be solved, and the means by which it has been solved have been the points of greatest interest, and in this respect the present machines are no exception. The justifying mechanism will be explained in due course.

In order to clearly explain the action of the composing machine it is necessary to first explain the construction of the type cylinder of the transfer printing machine, and this is shown in Fig. 1. The type are arranged in rows and in circles, and in order to indicate a given letter it is only

necessary to indicate its row and its number in that row, and this is done by punching two holes in the paper strip, the position of one of which determines the row while that of the other determines the position in that row.

Fig. 2 illustrates the composing machine, the keyboard being at the left, the punching mechanism at the right and the justifying determinator in the center. It is unnecessary to go into the action of the keyboard upon the punching machine in detail. Suffice it, therefore, to say that the connections between the two are purely electric. The depressing of a key causes a pin plunger to enter a mercury cup and thus to make connection with and energize the proper electro-magnet, of which a set are arranged in a row and are shown surrounding the base of the punching machine. We may, however, say that to avoid sparking at the surface of the mercury cups a secondary closing and opening switch with platinum points is provided which is operated in common by all the keys. The key first enters its pin in the mercury, thus determining the proper circuit, and then closes this switch. Conversely, when the key is released the switch is first opened, breaking the circuit, and then the pin is withdrawn.

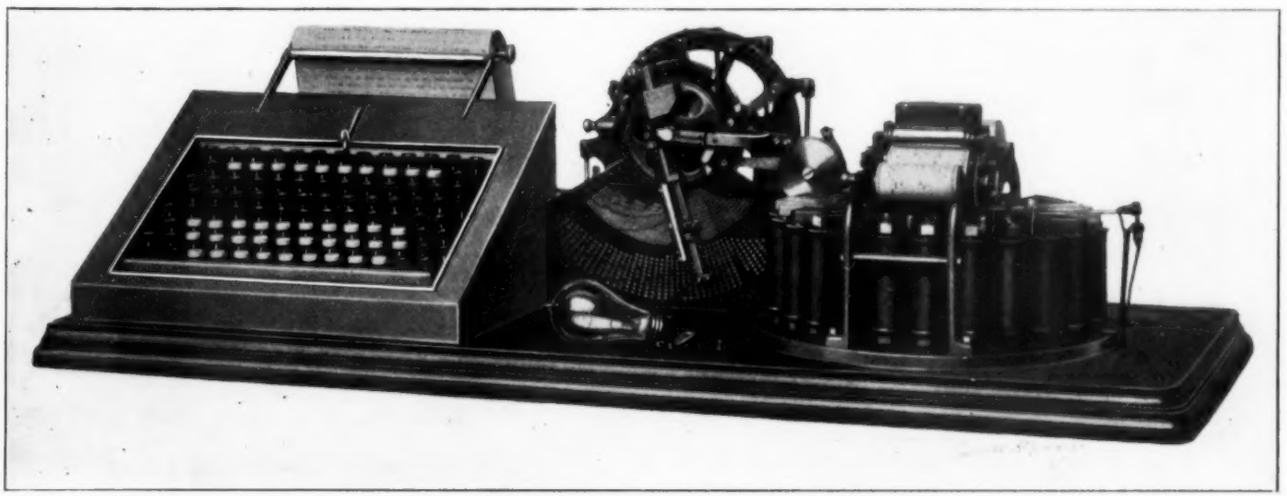


FIG. 2. COMPOSING MACHINE.

The justifying device is of extraordinary interest, and close attention on the part of the reader will be necessary to follow its operation, though that interest will be well repaid.

The letters are divided into imaginary units of width and are classified in accordance with the number of units which they contain—2, 3, 4, 5 or 6, as the case may be—and, we should add, all letters in a given circle of the type cylinder, Fig. 1, contain the same number of units, the circle in which a letter stands thus indicating the number of units which it contains. The width of a letter must be taken into account in two ways. First, after a letter has been printed on the slip by the transfer printing machine, the paper must be advanced by an amount equal to the width of the letter, whatever that may be, in order that the succeeding letter may be suitably spaced from it. Secondly, the units of width of each letter must be successively subtracted from the number in a full line and the final remainder be divided by the number of spaces between the words in the line in order to determine the amount of space to be placed between the words. For the purpose of this division the full unit is not sufficiently small, and hence the units are divided into tenths. Our readers will not fail to note that a machine which does all these things comes very near to the process of thinking, but, as will be shown presently, it does still more than this.

Fig. 3 shows a short section of a punched strip with its interpretation in ordinary letters below. The holes on the extreme edges are for feeding the paper through the second machine, while all the others have a meaning. The holes in the lower side determine the row in the type cylinder, Fig. 1, in which the letters are situated, while those in the upper side determine the position in that row. The lowest holes next the feed holes, which occur between each word, are space trips and indicate normally a movement of the paper without the impression of a letter, and nothing more. Similarly the hole marked "line trip" indicates nothing but the end of a line, and that preparation for justification must be made.

Referring to Fig. 2, a series of fan-shaped electrical contacts will be seen in the justifying determinator with a radial arm swinging over them, the principle of these contacts being more clearly shown in Fig. 4. The arrangement of these contacts differs in the two illustrations, though the principle is the same, and as the arrangement of Fig. 4 is the simpler to describe, we will confine ourselves to it. Of this figure the radial line *a b* represents normal spacing of three units. At the beginning of the composition of a line the contact points of the swinging arm are at the radius of the upper pair of rows of the fan-shaped collection of contacts and at their left. Should the line contain but two words—that is one space—the contact points of the arm would not descend below this position. On the beginning of the third word, or rather on the depression of the space bar of the keyboard before this word, the radial arm descends to the second pair of rows of contacts, and on the next depression of the space bar to the third pair, and so on, the position of the arm with respect to the rows of contacts which it fronts at the end of a line being determined by the number of spaces in the line, and thus indicating the number by which the remainder of the line, after the sum of the letters has been subtracted, must be divided for justification.

Not only does the arm move radially with the depression of the keys, but it also swings about its center from left to right. These latter movements are made at each depression of a key or of the space bar, in the former case representing as many units as the letter for which the key stands contains, and in the latter three units for normal spacing. Each movement thus subtracts a certain, though variable, number of units from the full line, and the final position of the swinging arm short of the position of the line *a b*, Fig. 4, shows the surplus total space above three units per space which must be divided among the spaces and then be added to the three units each in order to fill the line.* The reader will note that of the heavy circles of Fig. 4 all on the line *a b* are marked 3, indicating normal spacing. To take the simplest possible case, that of a line with two words only, if those two words and the intervening normal space of three units exactly fill the line, the contact points of the lever at the completion of the line will rest on the upper 3 and the light zero circle below it, and that number of units will be given to

* The arm may also swing to the right of the line *a b*, and thus give less than normal spacing, but into the action in this case we will not enter.

the space. Should the end of the last word find another unit lacking, the contact point will rest upon the upper 4 and that number of units will be given to the space. Should the line contain three words or two spaces, the second depression of the space bar will cause the lever to drop to the second pair of rows of contacts, marked "2 spaces," and should the three words and the normal spacing exactly fill the line, the contact point at the end of the last word will fall upon the second three of the line *a b*, and three units will be given to the spaces as before. Should, however, the last letter find another unit lacking, the spaces to be filled in justifying aggregate $3 \times 2 + 1 = 7$, which must be divided among two spaces, giving 3.5 units to each space. This amount of spacing is shown by the left-hand 3 of the 2-space group of contacts and the 5 below it. The final resting places of the contacts are telegraphed to the punches, and two holes, one for the number of units and one for the number of tenths appropriate to each space, are punched in the paper, as shown in the line *a b* of Fig. 3.

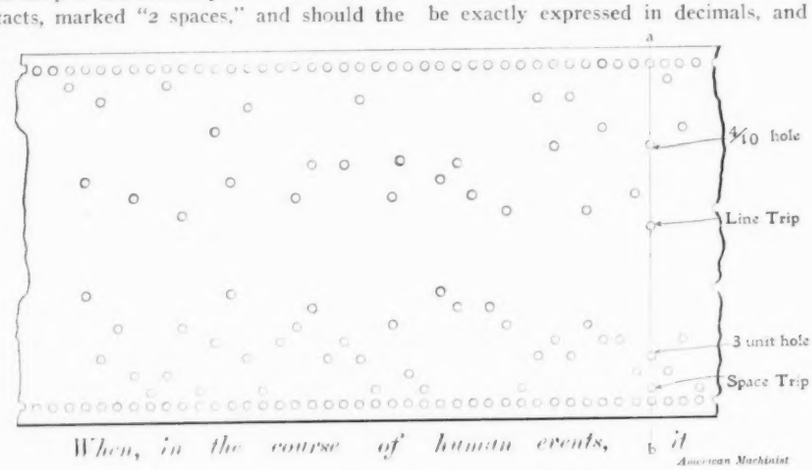


FIG. 3. EXAMPLE OF A PUNCHED STRIP.

It will thus be seen that the final position of the arm in a radial direction indicates the number of spaces in the line, while the position circumferentially indicates the number of units and tenths appropriate to each space. In the case chosen, however, the final division into 3.5 units per space is exact, and as this does not often occur provision must be made for this fact.

The result of dividing the total justifying space by the number of spaces in a line is usually a vulgar fraction which cannot be exactly expressed in decimals, and in all such cases the figures marked on the justifying indicator show the next even tenth above the true value. For example, assume a line of seven words or 6 spaces of which the last letter is short, say, 10 units of a full line. The normal spacing between words being 3 units the total space to be divided is $3 \times 6 + 10 = 28$ units, and these divided among 6 spaces give $\frac{28}{6} = 4\frac{4}{6} = 4.666 +$ units per space, which the machine interprets as 4.7. This interpretation will be found in Fig. 4, in which the tenth pair of circles to the left of the *a b* line in the 6-space set of contacts will be found to read 4.7.

It will thus be seen that the justifying indicator telegraphs to the punches the amount of space required between the words of a line in units and tenths of which the tenths are usually in excess of the true value, and this, unless corrected, would result in giving too great a length to the line, and, while what has been said is still fresh in the reader's memory, we will give, in outline, the manner in which this correction is made in the transfer printing machine.

In no case do any odd tenths appear in the actual spaces. The machine gives to the first space the number of units only which are telegraphed to it and continues to do this until the accumulated tenths due to the spaces which have been passed equal or exceed a unit, when that space is made wider than the preceding ones by this additional unit. To the next space it gives the whole units again, accumulating the tenths left over, if any, and those telegraphed to it until they again equal a unit, when this unit is added to the next space and so on to the end of the line when any remaining tenths are thrown away and this final throwing away of the final tenths corrects the error due to the use of the tenth next above the true value due to the division. To illustrate this, assume a line to contain 200 units and the sum of the units of the letters of a line to be 180, while the number of spaces is 6. The total number of units to be divided among the spaces is thus $200 - 180 = 20$, and as these 20 units are to be divided among 6 spaces the exact spacing, were all spaces equal, would be $\frac{20}{6} = 3.333 +$, which quantity the justifying indicator interprets and sends to the transfer printing machine as 3.4. The actual spacing done by the latter machine will then be as follows:

SPACE	
1st . . .	3 units with 4 tenths accumulated
2nd . . .	3 units with 8 tenths "
3rd . . .	4 units with 2 tenths "
4th . . .	3 units with 6 tenths "
5th . . .	4 units with 0 tenths "
6th . . .	3 units with 4 tenths "
Total,	20 units as required and 4 tenths left

Inasmuch as the 4 tenths remaining at

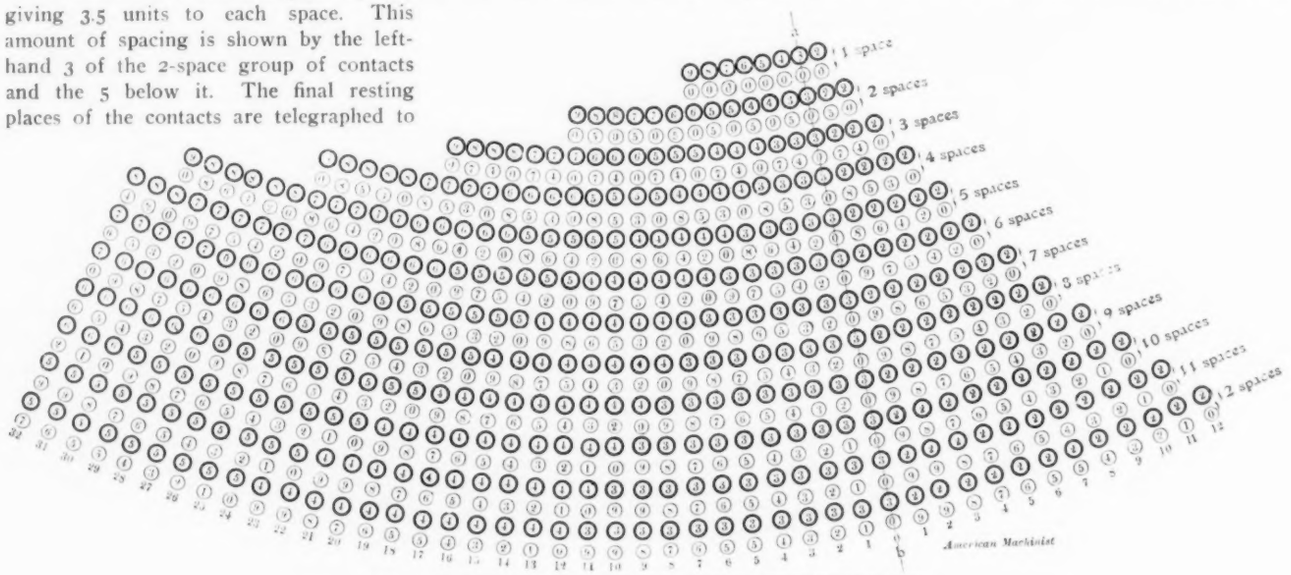


FIG. 4. ELECTRICAL CONTACTS OF JUSTIFYING DETERMINATOR.

the completion of a line are ignored by the transfer printing machine, it will be seen that the total spacing given by it aggregates 20 units, which is the amount desired, and this result always follows.

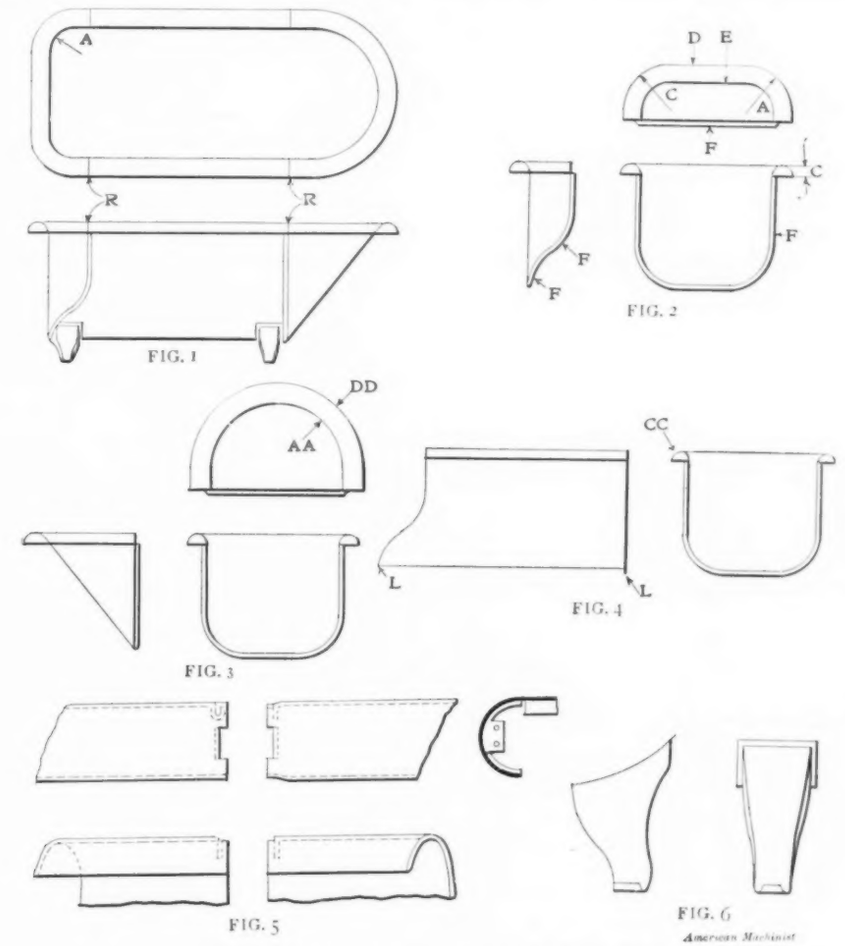
(Concluded next week.)

Press Work in the Manufacture of Bath Tubs.

Among the more recent achievements in the press working of sheet metals is the making of bath tubs entirely of pressed steel. They must of course be made in large numbers to warrant the outlay for presses and dies, but when the apparatus is all provided the product is not only cheap but excellent, with novel and desirable features of its own. In the making of such articles as bath tubs the sizes of the parts and the power required in the operations constitute a large factor of expense and involve additional difficulties of manipulation.

The Toledo Machine & Tool Company, Toledo, Ohio, have recently produced an entire equipment of shears, presses and dies for this work, making the entire tub, its legs, overflow pipe and fittings. The tub is indicated in Fig. 1 in the accompanying sketches. As will be seen, the entire body of the tub is made of but three pieces. The rim or top of the tub, instead of being a detached piece, is made integral with the body and ends, this feature involving one of the few difficult sheet-metal problems which are now receiving practical solution.

The piece for the rear end of the tub is shown in Fig. 2. The inner radius at *A* at the top is 6 inches, the width of the rim at *B* is 2½ inches and the depth of the rim at *C* about 1 inch; the difference, therefore, between the radius at *A* and the radius at *C* is nearly 3 inches, and the difference in the periphery of *D* and of *E* is about 5 inches, which suggests the difficulty of working these parts into shape without either splitting the outer or buckling the inner edge. The blank is first cut to shape with ordinary cutting dies and in the second operation it is formed to the proper radius at *A A* in ordinary sheet-metal forming rolls. The power press built for this special work comes in here and in this the operation of curling or forming the top edge is done. A second set of dies flattens or forms the rim at right angles and a third operation curls over the outer edge and finishes the shaping. The first operation was by far the most difficult. No blank holders or pressure rings were used in forming the edge, the operation showing how surprisingly the metal can be made to fold or flow if the dies are correctly adapted to the work. Additional dies next prepare the edges *F* for seaming, one operation bending the edge at a right angle all around and a second operation throwing it over about 45 degrees more, when it is ready for seaming to the body of the tub.



PRESS WORK IN THE MANUFACTURE OF BATH TUBS.

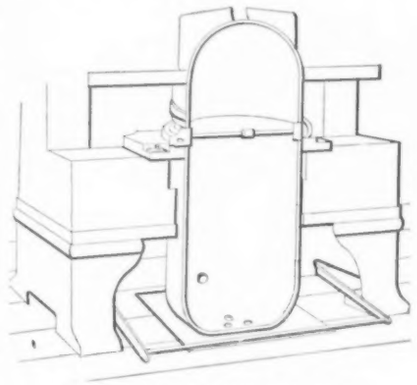


FIG. 7. ASSEMBLING THE TUB.

The front end piece of the tub is shown in Fig. 3 and the operations upon it are so similar to those above enumerated that it is not necessary to particularize.

The body, Fig. 4, having been cut to proper shape, has its top edges shaped in two strokes of the press and with but one set of dies; this being accomplished by a special gage or locating device operated by a hand lever. The upper die descending forms the first bend when by the operation of the one lever the gage is thrown out of the way, permitting a second set of gages to come into play by which the sheet is so located as to form the second bend and complete the rim. The body is then shaped by rolls to match the already prepared ends and the edges *L* are bent out at right angles.

In the assembling operation the rear end piece, Fig. 2, is first placed in position over the corresponding end of the body piece and the two are placed in the dies and at one stroke of the press they are neatly and firmly seamed together. The front end of the tub is next placed over the front end of the body, then they are placed in the dies and seamed in the same way, this operation being shown in Fig. 7. The press employed for this work is made with an open or removable front, which makes it possible to place the tub in the position shown.

Attention should be called to the manner of securing the seamed joints in the rim at the points indicated by *R R* in Fig. 1. A surplus of metal is left on each edge and by means of dies provided this is notched, shaped and perforated as shown in Fig. 5, the operations being performed simultaneously with those previously described.

The shape of the body of the tub allows all the legs to be made alike and these are produced complete in six operations for each. The making of the overflow pipe, which it is not necessary to describe, completes the job.

A German View of the Premium Plan—II.*

BY B. SCHILLER.

The tables show a comparison of the results of the various systems, the base piece-work price or labor cost being set at $3.00 and three ratings of respectively 20, 30 and 40 cents an hour being considered. Table 1 shows the rates of pay

z	$Z-z$	zl	$(Z-z)lp$	$K=Lz$	L	M
Actual time of production.	Time saved.	Earnings at hour rate.	Premium.	Total earnings or labor cost.	Rate of earnings.	Increase of earnings over rate.
hrs.	hrs.	cts.	cts.	cts.	cts. per hour.	per-cent.
20,32	0	406,4	0	406,4	20.	0
20	0,32	400	3,2	403,2	20,16	0,8
18	2,32	360	23,2	383,2	21,28	6,4
16	4,32	320	43,2	363,2	22,57	12,8
15	5,32	300	53,2	353,2	23,54	17,7
14	6,32	280	63,2	343,2	24,51	22,5
12	8,32	240	83,2	323,2	26,93	34,6
11	9,32	220	93,2	313,2	28,47	41,4
10,16	10,16	203,2	101,6	304,8	30,00	50.
10	10,32	200	103,2	303,2	30,32	51,6
9	11,32	180	113,2	293,2	32,57	62,8
8	12,32	160	123,2	283,2	35,40	77.
7	13,32	140	133,2	273,2	39,02	95,1
6	14,32	120	143,2	263,2	43,86	119,3
5,8	14,52	116	145,2	261.	45.	120,5
5	15,32	100	153,2	253,2	50,64	153,2
4	16,32	80	163,2	243,2	60,80	204.
3	17,32	60	173,2	233,2	77,73	288,6
2	18,32	40	183,2	223,2	111,60	408.
1	19,32	20	193,2	213,2	213,20	966.
0	20.	0	200.	200.	0	0

Maximum time allowance (Z) = 20.32 hours.
Day rate (l) = 20 cents an hour.

TABLE 1.

z	$Z-z$	zl	$(Z-z)lp$	$K=Lz$	L	M
Actual time of production.	Time saved.	Earnings at hour rate.	Premium.	Total earnings or labor cost.	Rate of earnings.	Increase of earnings over rate.
hrs.	hrs.	cts.	cts.	cts.	cts. per hour.	per-cent.
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
$13\frac{1}{3}$	0	400	0	400	30.	0
12	$1\frac{1}{3}$	360	20	380	31,66	5,50
11	$2\frac{1}{3}$	330	35	365	33,18	10,06
10	$3\frac{1}{3}$	300	50	350	35.	16,66
9	$4\frac{1}{3}$	270	65	335	37,20	24.
8	$5\frac{1}{3}$	240	80	320	40.	33,33
7	$6\frac{1}{3}$	210	95	305	43,50	45.
$6\frac{2}{3}$	$6\frac{2}{3}$	200	100	300	45.	50.
6	$7\frac{1}{3}$	180	110	290	48,30	61.
5	$8\frac{1}{3}$	150	125	275	55.	85.
4	$9\frac{1}{3}$	120	140	260	65.	116,7
3	$10\frac{1}{3}$	90	155	245	81,60	172.
2	$11\frac{1}{3}$	60	170	230	115.	283,3
1	$12\frac{1}{3}$	30	185	215	215.	616,7
0	$13\frac{1}{3}$	0	200	200	0	0

Maximum time allowance (Z) = $13\frac{1}{3}$ hours.
Day rate (l) = 30 cents an hour.

TABLE 2.

z	$Z-z$	zl	$(Z-z)lp$	$K=Lz$	L	M
Actual time of production.	Time saved.	Earnings at hour rate.	Premium.	Total earnings or labor cost.	Rate of earnings.	Increase of earnings over rate.
hrs.	hrs.	cts.	cts.	cts.	cts. per hour.	per-cent.
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
9,83	0	393,2	0	393,2	40.	0
9	0,83	360	16,6	376,6	41,84	4,6
8	1,83	320	36,6	356,6	44,87	11,4
7,86	1,97	314,4	39,4	353,7	45.	10,3
7	2,83	280	56,6	336,6	48,08	20,2
6	3,83	240	76,6	316,6	52,76	31,9
5	4,83	200	96,6	296,6	59,32	48,3
4,92	4,91	196,6	98,3	294,9	60.	50.
4	5,83	160	116,6	276,6	69,15	72,9
3	6,83	120	136,6	256,6	85,52	113,8
2	7,83	80	156,6	236,6	118,3	195,7
1	8,83	40	176,6	216,6	216,6	441,5
0	9,83	0	196,6	196,6	0	0

Maximum time allowance (Z) = 9.83 hours.
Day rate (l) = 40 cents an hour.

TABLE 3.

OPERATION OF THE SCHILLER PREMIUM PLAN FOR RATES OF 20, 30 AND 40 CENTS AN HOUR WHEN A JOB OF WHICH THE NORMAL PIECE-WORK PRICE (K) IS $3.00 IS COMPLETED IN VARIOUS TIMES.

actually earned and the actual cost when the job is completed in five hours. In the Halsey system the premium is taken at one-half.

Table 2 shows the rates of pay earned and the time taken if the labor cost is to be reduced in all cases from $3.00 to $2.25. Table 3 shows the labor cost and the time taken if all three men earn 45 cents an hour. These tables show that from the workman's point of view the Ross system appears to be the most desirable, as with less exertion a higher rate can be earned. From the employer's point of view the Halsey system appears theoretically the most desirable, because with a low rate and a rapid production the labor cost is the least.

The previous considerations have all been based on a shop working on day rates which is to be changed to the premium system. If the change is to be from piece work to the premium system, further consideration is necessary.

In introducing a change in the method of payment difficulties are met with all along the line. The men look on the change with a certain suspicion which is easily understood if their point of view is considered. Arguing from the fact, which is well founded, that the change costs the employer a considerable amount of time and trouble, the man looks for the real reason for the change. He cannot ascribe it to pure philanthropy and he does not readily believe that his employer is suddenly making a gratuitous attempt to increase his wages. He therefore comes naturally to the conclusion that the change is really to effect a reduction in wages. As a matter of fact, one can hardly expect the workman to immediately grasp the real meaning of a system which for the employer has been carefully studied and thought out; he will therefore not be ready to recognize the advantages, but will rather be on the look-out for the disadvantages of the system.

When the question is reduced to its lowest terms, it is immaterial to the workman how his wage is calculated. He is only interested in the simple relation—so many hours a week worked, so much money on pay day.

If the new system under similar conditions with equal diligence and equal work gives him less money, he has no use for it and will resist its introduction. For a system to be acceptable and popular it must give equal results at the start and offer advantages in the future. It is proven that the premium plan can offer advantages, but it must be so arranged that even from the start it does not show any disadvantage. If now we compare the conditions of piece work and day rate, we shall see that the rate of working is considerably higher for piece work, but that the rate of earnings is by no means always proportional to the capacity of the man. It is well known that the rate of wages

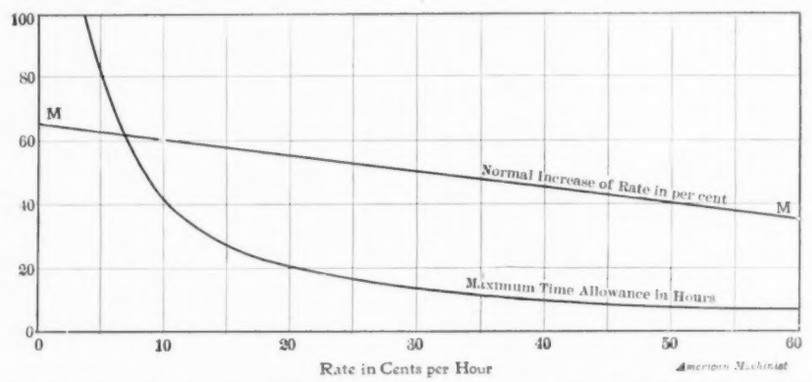


FIG. 3. RELATION BETWEEN RATE, NORMAL INCREASE IN RATE AND MAXIMUM TIME ALLOWANCE. TIME ALLOWANCE IS CALCULATED FOR A PIECE-WORK PRICE OF $3.00.

earned must not exceed a certain limit, and that this limit does not coincide with the maximum capacity of the man. Where there is much variation in the fundamental rates this will be particularly noticeable, and everyone knows how mistakes in prices are continued, the men being careful not to disclose them by earning too

*Abstract of a paper by Chief Engineer Schiller of Vienna published in the *Zeitschrift des Vereines deutscher Ingenieure* for August 22, 1903. Translated by Lawford H. Fry.

much money. The most careful time keeping cannot prevent an easy contract being charged with work done on a less favorable contract. The result is a sort of unstable equilibrium and an incorrect estimate of costs.

It is only in shops where a man is doing the same work day in and day out that the conditions are more favorable, but it is universally the case that the piece-work price is reduced until the man's earnings remain constant at a certain amount or at a certain percentage of his rated wages. The author has devised a premium plan for use in a shop in which piece work was established. Each man has a certain day rate, and each job is given a certain piece-work price. The maximum time allowed for the job takes into account, as explained below, both the piece-work price and the man's day rate. If the job is done in less than the maximum time allowed, the man receives as premium his day rate on one-half of the time saved. It is assumed that the piece-work price is so made up that when the job is done in normal time (which is less than the maximum allowed time) the man will be making his day rate plus a certain percentage of the same. With straight piece work the price would be cut if this certain percentage is exceeded, but in the premium system the prices are maintained regardless of earnings. In the Schiller system the extra percentage earned by doing the work in normal time is not the same for all classes of men; it varies, as shown by the sloping line MM in Fig. 3, from 35 per cent. when the day rate is 60 cents an hour to 60 per cent. when the day rate is 10 cents an hour. Of course any other relation can be arranged to suit local conditions. This handicapping of the more highly rated men appears to be equitable, in view of what was said above regarding the fixing of the day rates.

The maximum allowed time is so chosen that when the job is done in the normal time the effect of the premium for the time saved is to give the man the maximum wage he would be allowed to earn at straight piece work, the cost to the employer being kept the same. Under this system the change from straight piece work makes no difference to either employer or men, so long as the work is done in the normal time. Any reduction of time increases the earnings and reduces the labor cost. The curve in Fig. 4 shows the relative rate of increase in earnings for the Schiller system and straight piece work. With the Schiller premium plan the rate of increase is less rapid than with piece work, and this gives, so to speak, a factor of safety to enable the original piece-work price to be rigidly maintained in the face of reduced time of production.

The following figures show the operation of the Schiller system with three men rated respectively at 20, 30 and 40 cents an hour and working on a job of which the piece-work price is $3. The maximum allowable times are respectively 20.32, 13.33 and 9.83 hours, and if all three men are to earn the same rate of 45 cents an hour, the actual times of production and the labor costs will be:

Rate, cts. per hour.	Time, hours.	Labor Cost.
20	5.80	$2.61
30	6.66	3.00
40	7.86	3.537

If the job is done by all in the same time of five hours, the earnings and costs will be:

Rate, cts. per hour.	Rate actually earned, cts. per hour.	Labor Cost.
20	50.64	$2.532
30	55.0	2.75
40	59.32	2.96

If the labor cost is to remain at the full piece-work price of $3 in all three cases, the times of production and earnings will be:

Rate, cts. per hr.	Time, hours.	Rate actually earned, cts. per hour.	Per cent. increase over rate.
20	9.68	31	55
30	6.66	45	50
40	5.17	58	45

This is the so-called normal rate of production. The maximum allowed time is fixed with a view to giving these percentages of increase when the job is produced at a labor cost equal to the piece-work price. It will be seen that when all the men do the job in the same time their earnings are not greatly different. A still closer agreement can be reached by a suitable choice of the percentage increase of wage when the labor cost is normal.

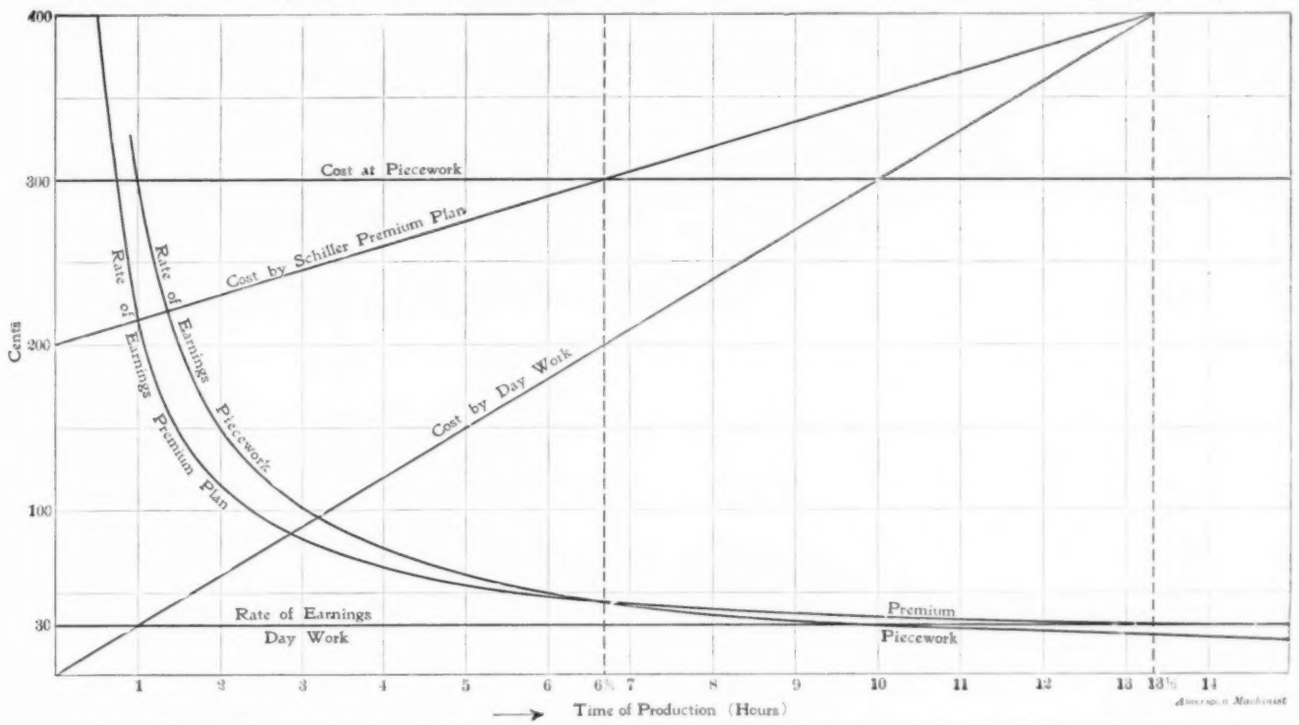


FIG. 4. COMPARISON OF RATES OF EARNINGS AND LABOR COSTS FOR PIECE WORK, DAY WORK AND SCHILLER PREMIUM PLAN.

To show how the maximum allowable time for various rates and piece-work prices is obtained, a little algebra is necessary.

Let l = rate in cents per hour,
L = rate actually earned,
M = per cent. of increase of wage, so that $L = l + Ml$;
K = piece-work price,
z = time actually worked,
Z = maximum allowed time,
p = rate of premium (here $p = \frac{1}{2}$).

Then under assumed normal conditions

$$K = zL = z\,(l + Ml)$$

also $$K = zl + (Z - z)\,pl;$$

hence $$Z = \frac{K}{l}\left(\frac{1}{p} - \frac{1-p}{p\,(1+M)}\right)$$

or putting $p = \frac{1}{2}$,

$$Z = \frac{K}{l}\left(2 - \frac{1}{1+M}\right)$$

Then by inserting the values of piece-work price K, rate l and normal percentage of increase of rate M, the maximum time to be allowed in any case is found. This is done in the original paper for piece-work prices of from 1 to 30 and for rates of from 10 to 42. M is taken to vary with the rate, as shown by the line MM in Fig. 3, the equation being:

$$M = 65 - \frac{l}{2}$$

It will be seen from the above that: 1. The higher the rate the lower must be the time of production to maintain the same labor cost. 2. With different rates and the same time of production the earnings are approximately the same. 3. The lower the rate the lower the labor cost for equal times of production.

In other words, the highly rated man is assumed to be the more capable, and must do the work in less time than the man with a low rate, in order to earn the same money; a newly engaged operator who is started with a low rate has an opportunity to earn as much as his more highly rated senior if he does the same work in the same time.

The cost of production is greater with a highly rated man if he does not employ his time properly, just as on a day-rate system, but there is no incentive to industry while with the premium system every hour saved means an increase in earnings, which is the greater the higher the original rate is.

The variability of the time allowance has a further advantage. It is impracticable to refuse the operator any increase of wages. In all other systems, however, an increase of rate means an increase of earnings and labor cost if the time of production remains the same. In the present system this is not the case. With an increase in rate comes a reduction in time allowance, so that earnings and labor cost equalize themselves. It is to be assumed, however, that an increase in rate is due to increased ability which brings with it a reduction in the time of production so that the man's earnings are increased without an increase of the labor cost.

Further, if it is considered that a workman's ability increases up to a certain point and then with increasing years declines while the rate is continually increased, the condition assumed above does not obtain, and the employer is paying to the old and industrious workman a sort of pension which the man has well earned and which may be readily conceded to him. In any case it is easier to deal with a request for a raise under this system than where an increase means a direct increase in the cost of the product or a reduction in the employer's profit.

Since the allowed time is a function of the original piece-work price, a comparison of the costs in the two cases is a measure of the efficiency of the workman. If the cost has been reduced, other conditions being the same, the workman will have earned more by reducing the time of production by greater industry. Under these circumstances there is no objection to an increase in rate.

By the use of this premium system the works manager is in a position to determine very closely the workman's ability and the actual cost of production. An incapable, idle or thoughtless man will fare badly, he will not be able to reduce the former piece-work cost and may even increase it without, however, earning more for himself. He will find that the shop is not for him. The result of the system when properly applied is a shop with capable, industrious men, earning good wages and giving a rapid and economical production, the efficiency of the whole plant being increased.

A similar procedure can be carried out if a piece-work system is replaced by the Rowan or the Ross premium plan, the fundamental idea, that equal work shall bring equal earnings irrespective of rate, being maintained.

It is worthy of mention that all the premium systems of which descriptions have been published have given good results in practice. The question is as to which is most suitable, and this can only be decided after a careful examination of the local conditions.

A New British Electrical Magazine.

Mr. Theo. Feilden, who some years ago launched the "militantly British" *Feilden's Magazine*, the editorial management of which he relinquished two years ago, has just published the initial number of *The Electrical Magazine*, a copy of which is before us.

The new magazine makes its appearance with quite a flourish of trumpets, the first cover page carrying in red ink the legend "a revolution in electrical literature," while the salutatory informs us that the organization "is of a peculiar—I might almost say unique character" and abounds in mysterious references to the features of this organization. While the new magazine is a creditable and useful publication, we can see nothing about it of the unique character which would be expected from its publisher's announcement, and its creditable features would perhaps be more noticeable if there was somewhat less of blare.

To write black on glass or bright metal, use 1 to 2 parts of silicate of soda with 10 parts of liquid India ink. Write with a steel pen.

Hardening Machine Tool Parts.

BY JOHN RANDOL.

In the Sloan & Chace shops, Newark, N. J., fine small lathes and gear cutters have been made for more than thirty years, and the running spindles of these delicate watchmakers' machines must be hardened with entire uniformity and with as little distortion as possible.

Up to within something more than a year the usual course of fine tool-part hardening was followed, by use of a gas-furnace heated pot of melted cyanide of potassium. The pieces so treated often showed different degrees of hardness, sometimes cracked in quenching, very often were so distorted as to have to be straightened, and there was a constant and large loss by breakage in either quenching or straightening.

This hardening passed into the hands of Mr. William Haney, who set the cyanide pot aside and also abandoned the use of tool steel; taking machine steel, 35 carbon, for his material, and hardening the finished pieces by the use of a compound not generally employed, with the result of work uniformly hard, very strong, showing a bright, fine-grained fracture, unchanged in form, requiring no straightening and with no loss from breakage.

Mr. Haney's hardening compound is composed, by weight, of three parts of prussiate of potash and one part each of table salt, sal-ammoniac, rosin, and bone charcoal, and one-half part of cyanide of potassium.

The prussiate and cyanide, salt and sal-ammoniac and rosin are to be coarsely powdered, so as to pass through a sieve 16 meshes to the inch. The animal charcoal is ordinary ground "bone black."

A sufficient quantity of the powdered materials, in the proportions specified, is mixed, dry, with the bone charcoal, some latitude as to the quantity of the charcoal being allowed. The bone coal is not the active hardening substance in the compound, but if the pieces are packed without the charcoal, they are firmly embedded in the mass when it cools.

The routine is to pack the pieces to be hardened in boxes, as is usual in case-hardening, luting the covers on with clay. The boxes are then placed on the fire-brick bottom of the gas furnace shown in Fig. 1, which has four flames on each side and an overhead smokestack. The flame is put on for a sufficient length of time. The No. 5 lathe spindles, previously mentioned, take five hours of firing after they are red hot; smaller and thinner pieces take less time. No test wires are packed in the boxes, as the time of heating is determined by experiment at first, and the boxes are always kept in the same time for the same piece. The box is left in the furnace with the door closed until all is cold, and then the work, which is perfectly clean and silver-white, is reheated and quenched singly.

The spent granulated packing left in the

box after the work is taken out is used over again as bone charcoal about three times, the active case-hardening constituents of the packing being supposed to be dissipated at each heating. The spent residue is used alone to pack such parts of the work as are not to be hardened.

Mr. Haney uses three liquids for cooling work. Fig. 2 shows the case-hardening plant, and Fig. 3 the three hardening baths at the toolsmith's forge. The barrels contain water with common salt added, sufficient to make it float a potato. in varied proportions, a quenching bath for various degrees of softness may be had.

The glycerine bath is much better for water annealing than the soapy water commonly used. For "water" annealing the piece is cooled in the air before quenching until it will barely scrape sparks off the wooden handle of the smith's hammer, then quenching in the glycerine bath ensures a very soft quick-annealing.

As stated, this compound and method do not produce the case-hardening "colors." The work is a dull silver grey when cold. The hardening is extremely uniform, and extremely hard, and never shows soft spots, as did the tool-steel work heated in melted cyanide.

The case-hardening boxes shown in Fig. 4 are some of them cast iron and some of wrought boiler plate. Mr. Haney prefers the boiler-plate boxes, formed by cutting out the corners and bending the sides up with no fastening, out of steel plate 5-16 or 3/8 inch thick.

The cone spindle-boxes are hardened in individual round boxes, cut off from steel piping. The cones are 1 9-16 inches diameter by 1 3/8 inches long. The round-tube boxes, in which the cones are packed for conversion, are 2 inches diameter inside by 2 1/4 inches long. These are set in three rows on an iron plate, filled with cones and packing, and then covered with a second plate, and a second three rows of cone boxes are placed on top and covered, and then a third tier of cone boxes is added and covered, and the three-high pile is placed on the firebrick furnace floor and fired, and permitted to cool without being disturbed. The cones are then heated and dropped one at a time into the brine barrel. Mr. Haney does not use pure water for cooling hardened work. The brine bath gives much more depth and greater hardness than water gives, and is used for all plain work not likely to crack in hardening.

A costly cutter was made of *machine* steel by mistake, not at the Sloan & Chace

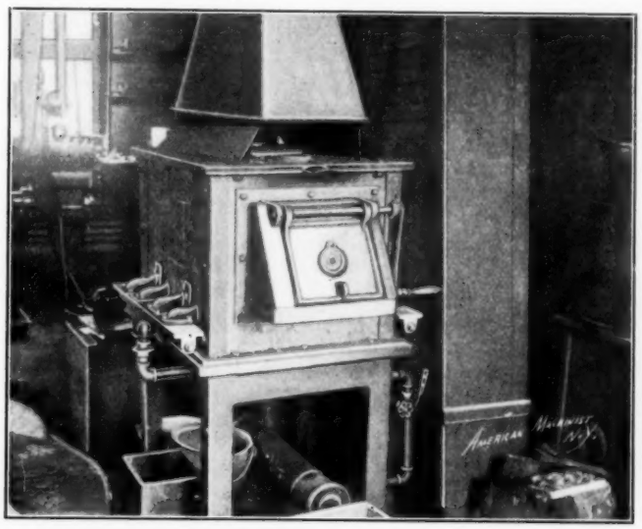


FIG. 1. CASE-HARDENING FURNACE—FOUR GAS FLAMES ON EACH SIDE.

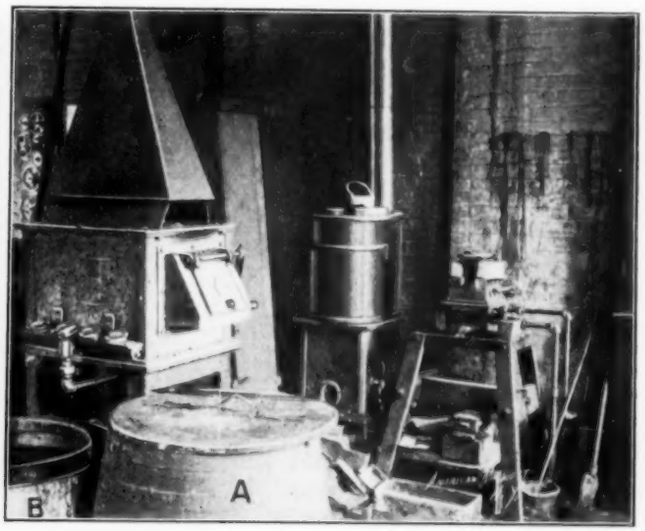


FIG. 2. CASE-HARDENING PLANT. FURNACE WITH CYANIDE POT AT THE BACK.

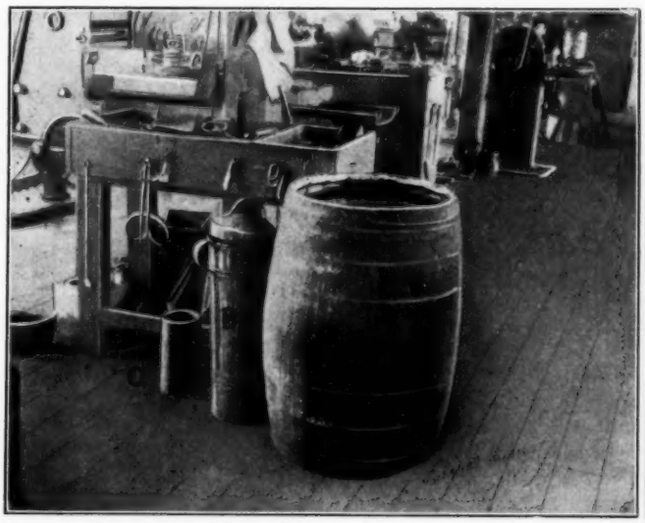


FIG. 3. DIFFERENT COOLING BATHS AT THE FORGE.

FIG. 4. CASE-HARDENING BOXES.

The covered sheet metal tanks contain fish-oil, which is preferred to animal oil as having the sharper action. The smaller receptacle, a metal can, at the forge, contains glycerine and water. In the illustrations the brine baths are marked *A*, the oil tanks *B*, and the glycerine can *C*.

The quenching is quickest and most efficient in the brine; more gradual and less harsh in oil, and somewhat sharper and quicker in glycerine alone than in water. By mixing glycerine with water

shops, and was sorely needed for use. Mr. Haney hardened it in five hours' case-hardening, and it did more work than any tool-steel cutter ever did on the same job.

Ten hours' firing after the work is red hot will give 3/8 inch depth of hardening with Haney's compound; 1½ hours' firing after the work is red hot gives 1-32 inch depth of hardening.

This case-hardening is thus fully detailed because it gives extremely good results, and because it is different from ordinary procedure. Fully detailed information of this kind is very rarely to be had where superior results are obtained, every successful case-hardener being inclined to keep his compounds and quenching baths to himself, as valuable trade secrets.

A Thickness Gage for a Buzz Planer.

BY JOHN M. RICHARDSON.

The patternmaker often has to do side jobs not exactly in his legitimate line, but which are brought on by it. Ten years or more ago I had occasion to make a case of small drawers to go on an automatic silk-winding machine. There were quite a number of these drawers to be made, and 3/8-inch stuff was called for on the case and all. As there was no cylinder—or dimension—planer in the shop, the only one being a buzz planer, I saw that

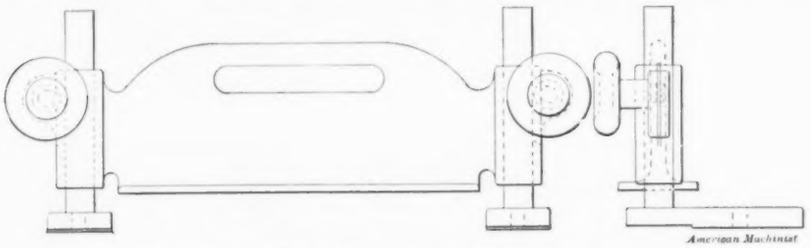


FIG. 1. ADJUSTABLE THICKNESS GAGE FOR BUZZ PLANER.

the circular saw was to be followed by a large amount of tedious hand planing, and the thought kept revolving in my mind as to whether there was not some possible way in which the pieces could be brought to a thickness on the buzz planer.

I began to experiment a little. Taking a piece of 2-inch hard pine, perhaps 4 inches wide and long enough to reach across the width of the planer, then nailing a strip 3/8 inch thick across each end, I clamped down the whole affair to the planer table with large hand-screws, the strips bearing on the table and leaving a 3/8-inch space between it and my pine strip. The affair was clamped to the table just beyond the knives, a part of it being directly over the back table and a part of it over the cutters and throat.

The table in front of the knives was lowered as far as possible (about ½ inch) and a piece of work to be planed to thickness was held entirely away from this, but firmly under the edge of the hard pine bridge above and pushed ahead until the end had passed the knives and rested on the back table. Then trouble began. The piece would stick and object to going ahead. It was found necessary to cut away clearance on the under side of the bridge strip, leaving but a narrow portion of it, the given 3/8 inch in hight, coming directly over the edge of the back table beyond the cutters. After this was done things worked nicely and the job was completed.

The success of the crude affair led to the making later of the device shown in Fig. 1, consisting of two posts clamped to the planer bed, just beyond the cutters, on which posts moved the bridge, which could be adjusted to any hight and securely held by two small hand-wheel tightening screws; the other two tightening screws, which were used to clamp the posts, being those ordinarily used to hold the fence in position.

Fig. 2 is a hight gage, being simply a piece of cast iron, about 3/4 inch thick, with the bottom and large end planed square and having steps milled on the incline, running by sixteenths from 2 inches downward, with the different sizes stamped on with steel figures opposite the steps. This was set on the planer table and slipped under the gate as a gage for any desired thickness of work. When the gage stood on end, it showed any hight by intervals of 1/4 inch.

Now for a word of caution: This device is not intended as a substitute for a dimension or pony planer, when the work of a shop will warrant the latter; but it will help out for occasional use. There is a knack in using it, and it may look a little dangerous at first, but the one just described was used as occasion required, for six or seven years to my knowledge, and no one was ever injured by it; it is probably still in use.

Short pieces less than a foot long should not be tried, neither do boards more than 8 or 10 inches wide work well, if very thin. One-sixteenth of an inch is the limit for a chip, and the planer must be stopped and the bridge lowered for each reduction in thickness.

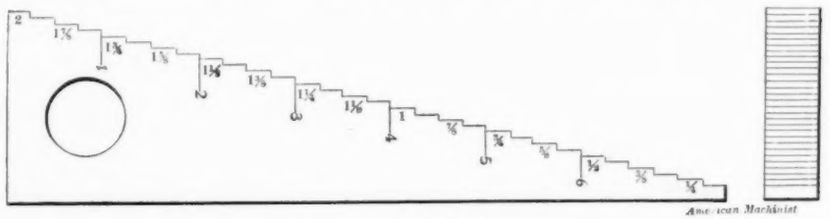


FIG. 2. CAST-IRON HIGHT GAGE.

To operate, first screw the device in place and set to the desired hight, and lower the front table as much as possible. Then start the machine and hold the work level, with the front end of it firmly against the bottom of the gate and push it ahead. It now passes the knives and slides along the back table, and all the while the piece is being planed it must be held with a gentle pressure upward, so as at all times to be in contact with the bridge; for if it is not, it will be gouged into by the knives, and the work will become uneven in thickness.

When the back end of the piece approaches too near the cutters to be held safely, simply grasp the part already passed and draw it through. By this time there will not be enough left in front of the knives to sag and cause the trouble I just referred to.

Bessemer as a Man.

The following is the conclusion of a lecture to the students of Sibley College by Robert W. Hunt upon the life of Sir Henry Bessemer:

Bessemer's character was a rugged one. His mind clear, powerful and conquering. He was of the material from which conquerors have ever been formed. The attainment of his end the one object. Quick to see and appreciate the smallest thing bearing on his quest, and equally rapid to assimilate and use it as his own. I do not mean that he was actually dishonest or dishonorable, but to him his own individuality was the greatest thing on God's footstool, and to it all things belonged. Still he must have been loyal to his friends because the Allens, Longsdons and Galloways and he were firm friends and allies

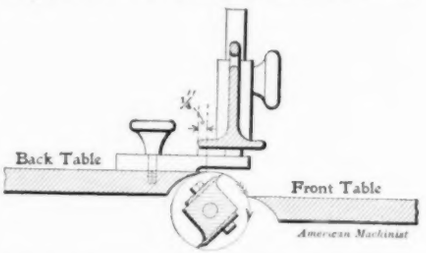


FIG. 3. SECTION SHOWING GAGE IN POSITION.

from first to last. But; and here is the point in Bessemer's character, the weakness in it, for which I feel sorrow and regret, almost amounting to contempt. During the years of his life after his great triumphs, he was a frequent writer, but by never a line or word did he give one iota

of praise or acknowledgment to either Mushet, Goransson or Holley. It is true he settled on Mushet an annuity of $1,500 a year, but Mushet had saved him from absolute defeat and disgrace. And I believe Mushet would rather have had the admission than the money.

Goransson has passed away since Bessemer, a successful and honored man. He did not require Bessemer's praise, but how graceful it would have been, if one laurel leaf from the conqueror's wreath had by him been placed upon his brow.

Bessemer contributed several papers to American technical societies, on the walls of the house of one of which, and of which Holley had been president, both of their portraits hang, but even Holley's name was never given in any of Bessemer's ego contributions. Holley did not need his praise. His, as well as Bessemer's, achievements will ever speak for themselves, but more than that, Holley died as the loved friend of every human being with whom he had ever been associated. Bessemer died leaving a great name, a great fortune, but mourned by few. Which was the nobler?

A Walking Locomotive.

United States Consul James Boyle sends from Liverpool an interesting account of the "Pedrail," which seems to be a successful, practical road locomotive for heavy haulage. The peculiarity of the machine is in its feet, for such it has in place of the usual wheels. The action of the feet will be understood from the accompanying cuts. It will be noticed that the foot carriers have a radial movement which enables them to accommodate themselves to the surface traveled over, so that usually three of the feet are in contact with the ground at once. The inclination of the bearing rail *A* is changeable under the control of the operator. The machine is entirely supported by its four sets of feet. It will not only go over all the usual obstacles of the roughest roads, but will climb the steepest hills and is said to be even capable of walking upstairs. The machine in use is equipped with a crane and will pick up and transport heavy loads. The inventor is Mr. Bramah Joseph Diplock, of London, and Professor Hele-Shaw recently made the machine the subject of an address before the Liverpool Self-Propelled Traffic Association, showing cinematograph pictures of the Pedrail in operation.

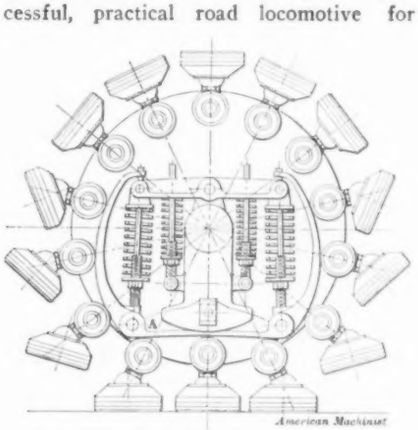


FIG. 1. THE PEDRAIL ON LEVEL GROUND.

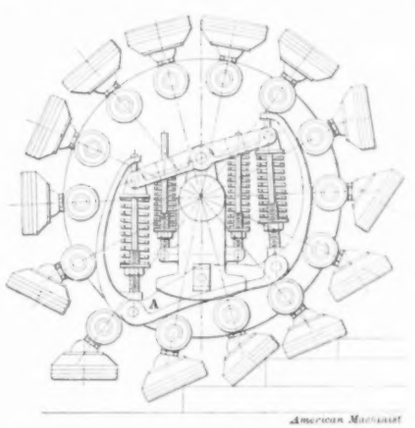


FIG. 2. ACTION OF THE PEDRAIL IN CLIMBING.

Echoes From the Oil Country—A Shop Opening.

The air had been filled for some months with rumors, and sub-rumors, of the wonderful new shop that was to show us denizens of the backwoods a sample of an up-to-date establishment. Don't understand me to say that the projectors of the new works made any disparaging comparisons, but this was to be a stock company and each stockholder, and the friends and relatives of each stockholder, wanted the rest of the surrounding districts to understand that here was a shop that would outclass anything that had ever before been attempted.

If by any chance a professional man came into the shop—our grindy little out-of-date one—he was sure before he left to tell us about the glories of the new one and ask if we had examined it. It was an oversight on his part if he did not bring shame and confusion on my head by putting me in the position where I had to acknowledge that we did not have a toolroom of any kind. I could readily interpret his thoughts as he would look at my dirty clothes and hands (and generally the face, too, had dirt enough on it to serve for purposes of identification), while I confessed that the only place that could be thought of as a stockroom was the office. That office was a gem, and I wish you could have seen it; there was only a little space in it (up beyond reach) that was used to hold a small supply of air kept for breathing purposes—but I didn't set out to tell you about the office—and as he would depart he would leave behind him, without charge, a feeling that if I didn't wake up the sheriff would be around in a short time, and that I would fully deserve it if he did come. On the street it was not much better. Worthy business men would pityingly intimate that it was too bad that that cornsheller was not good enough to draw in capital so that it could be built in a good shop.

Naturally, under such constant hammering, I was very much alive as to matters concerning this new shop, and as it was not many miles away I found time to visit it, in hopes of picking up some new ideas on shop construction and management. My first visit was when the shop was only partly erected. At this visit I had the pleasure of meeting the man who was furnishing the mechanical brains of the undertaking. With his business as a nucleus, a company had been formed, and the new undertaking had located the new works in a small city where the most of the stockholders lived. The principal advantage that this place held out was the fact that there was nothing else of the kind anywhere within a hundred or more miles.

This man, being a mechanic, received me as one, and spent time enough to show me over the entire plant, and to explain to me what it would be when completed. He was a good mechanic, had designed largely, and had made money in his former location. That there were some things that he did not like about the new place was not his fault; he had others associated with him, and they must have their say part of the time. Even in business it is a good thing to mind that this is a free country where the majority rules. It isn't a question, sometimes, as to whether that majority knows anything about the business or not. As we went through the works, and I noted the expense that was found necessary to get things into the shape they were to be, I could not help wondering if it was within the range of possibilities to make such a shop pay if our style of cornshellers was to be the output.

Seeing my interest in everything, my mechanical friend promised that I should receive an invitation to the opening, which he said the board of directors insisted was necessary to the proper starting of the works. Theoretically, they were not to do any work until that time, and at the appointed time the button was to be touched that was to start the wheels of industry which were to build up the town, and enrich the owners of the plant.

As such invitations start at the top and work down, if it had not been for his thoughtfulness I should not have had the chance to mingle with the quality on that glad occasion. The governor of the State and a real Senator of the United States and a general of some sort were there to address the people. After this was over there was a reception at the fashionable clubhouse, for the people with leisure, money and dress suits or silk dresses. The mechanics who were to be the bone and sinew of the works, and myself, mostly failed to connect with that part of the entertainment.

Brother machinist, did you ever stand at a machine with clean overalls on while

a crowd of people of all kinds, from farmers with mud on their boots to men in dress suits and ladies in silks and costly laces, looked you and your machine over, like they do the animals in a menagerie, and made all sorts of pertinent and impertinent remarks to and at you? After being to that opening I feel sorry for you if you ever did.

They are two beautiful ladies, and one is explaining to the other: "This, my dear, is an engine lathe; Mr. Blank told me so; he is the purchasing agent, you know. They are to use it to make engines. Are you" (to the machinist) "the regular engineer of this?" The man stammers and chokes, and gets red in the face, and his reply is not very distinct. The ladies pass on, while floating back from them comes something that sounds thus: "—— grade of intelligence needed is not such as we are —customed to."

This alert man that stops has success written all over him; he may run a store. "I suppose you know all about this machine?" Not knowing precisely what might be meant by "all" the machinist takes some chances as he nods assent; and this uncertainty runs through more of the talk.

"How much did it cost?"

"Several hundred dollars. I don't know exactly how much."

"What do you do with it?"

"Oh, I do anything that the boss gives me to do."

"How do you operate it when you have to make a lot of axes?"

"Axes? Why, this isn't a place where they make axes. This shop is to make machine tools—tools like this one maybe, or other ones for use in machine shops."

"What *is* the purpose of this machine, then, will you kindly explain?" in rather a hurt tone.

The machinist does his best to give his questioner, who is evidently entirely unacquainted with machine shops and machine-shop practice, some insight into the modes of operation necessary to produce work on a lathe. "I take a round piece and center it—that is, I put a hole in each end for this piece to go into. It is a center." Here he picks up a spare center. "I put a dog on one end, and when I get it in the centers I make it turn round by pushing over this handle. A tool held in this post cuts off as much as has to come off. These are some of the tools that I have to use." He picks up several from the tool board.

"Ah! you put a hole in it for the center." Somewhat sarcastically: "And is that all that this machine does, just going round and round?"

The man had to admit that it did not do much when it was not going round.

"In other words," broke in a scholarly looking man who had stopped and heard most of the talk, "you are trying to say that this is a machine for producing varied and various cylindrical forms of such combination and extent as the supervising manager directs, and that this is the extent of its usefulness and of your powers while used in combination with it. Is that not a concise statement of the facts in the case?"

As this statement seemed to satisfy the first man, the machinist thought it safe to nod an assent, and the men passed on.

"Now, Pard, you understand what a lathe is if you never did before," and I nudged him in the ribs. "Don't you wish that you had the privilege of the enlightening of such an audience every day?"

"This is worse than trying to cut a thread without the right gears," he returned. "You can bet your bottom dollar that if I had known that it was going to be anything like this they wouldn't have had me here to-day, job or no job. I wouldn't mind all the mechanics in the country, but when it comes to droves of people without the first signs of sense it is another thing. I tell you it is awful."

His hope of escape seemed small with that crowd surging around him. As I walked away I heard him trying to explain to a rosebud of a girl why he called a piece of metal with some marks on it a "scale." Probably the beauty of the questioner softened the shock somewhat when she sweetly murmured, "A nice young man over there, with brown eyes and curly hair, was showing me a kind of gage thing that he could measure thousandths of an inch with, *so he said*, and it had marks around on it as far apart as those are, and now you are telling me that these things are scales. A young man once told me he was a banker's clerk, and I found out that he worked in a machine shop in Oil City. Is that another name for machinists?"

I walked on to see what the man with the camera was doing. Under some decorations, with his hand raised in a peculiar manner, stood a dignified, elderly gentleman. The photographer was posing him carefully, but never moving that hand, which seemed to me to be in a very conspicuous but inartistic position. When he had done with the object he was working at, another, a large, important acting, fussy sort of man stood up and the same performance was repeated. When it was over my curiosity led me to investigate the mysteries of this strange part of the "opening," and I found that these "prominent citizens" were having the honor conferred upon them of being taken with their hands on the button that the governor had touched. Think of the significance that the opening will have for some families.

Yes, it well repaid for all the time that it took to go to the opening. There were many things to be seen that were of great and lasting interest. Some of them were mechanical, and some were not; also, some of them were good things to follow, and some were not; and just which was which was a matter of circumstance and opinion.

Once I was very young and uninformed, and I thought that the object of building a machine shop was to provide a place and means for producing useful articles of metal; I still think that it is—*sometimes*. I know of a number of people who are very thoroughly convinced that such a purpose is of very little relative importance in the plans of some who have succeeded in building shops. The Dutchman who tried to keep store with a partner had the experience left.

If I had the confidence of the man who originated the plans that culminated in the building of those works, and knew what it was that he was planning to be the outcome, I could tell you whether his plans were a success or not. As a means of making money for the common stockholder, they have not seemed to be. The mechanic who put his smaller business, and his years of savings and of experience into them does not hesitate to tell what he thinks of them. His story would not "bull" the price of industrial stock much in the estimation of a machinist.

When you think of building a home and settling down for life, thinking to continue at your trade with the company of your choice, it is well for you to reflect a little on the real purposes of the company before you conclude that because a costly plant has been built it is bound to be permanent.

Who are the real owners, and what do they know of the business?

Are they such people as have the same kind of aims as to the purposes the shop is to serve?

Are they all to use it as a dumping ground for their poor relations?

Are they all to use it as a means to further political ends?

Are they all to use it as a producer of currency for stock jobbing purposes?

Are they all to use it as a monument of their importance to the community?

Are they all going to try to see that it is a first-class place for making steam engines?

It depends on the vantage point of the interested party which of these objects may be, to him, the most important, but I do not think that anyone will dispute the assertion that they are extremely poor mixers one with the other.

If you are a young man who is content to get the most out of the present without regard to how long it may last; if you want all the trimmings you can get; if you like novelty and variety, any of the first shops may serve your purpose while they are new.

If you want to spend your life evenly and quietly and prosperously, you might consider the shop where the proprietor is watching what you are doing, and is taking care that for every dollar that he pays you he is receiving something that he can sell for more than a dollar. If you are reasonably careful that the amount of value he gets for your dollar's worth of

work is large and easy to find buyers for, he is not apt to want to get rid of you and he is apt to divide up reasonably with you, if for no other reason than just because he might fear that some other man running a shop for the same kind of a reason might be ready to do that kind of dividing.

Perhaps I was at the opening of the shop that you are thinking about, but my friend over yonder thinks it resembles a shop that is in his mind.

W. OSBORNE.

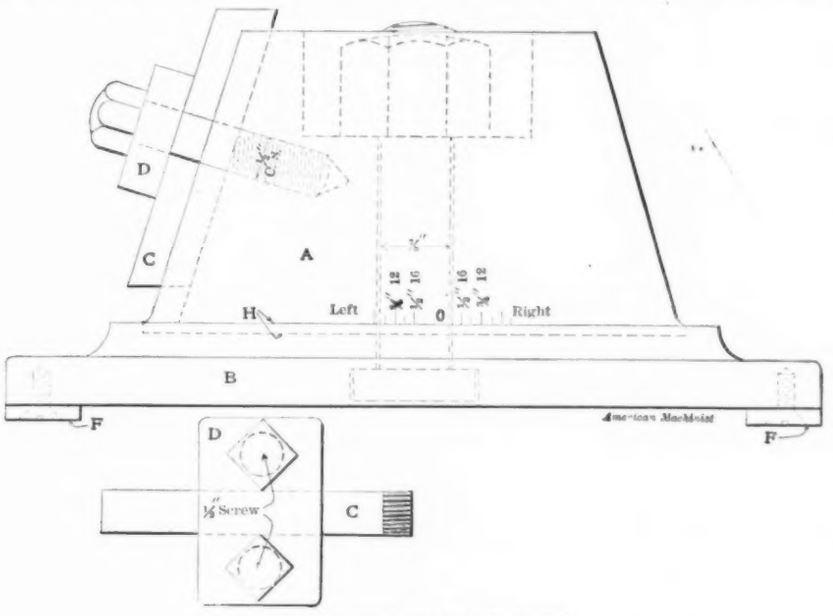
Letters From Practical Men.

A Chaser Cutting Attachment.

Editor American Machinist:

A simple chuck for holding stock for chasers is shown in the accompanying sketch. The stock can be cut all the way across at the proper angle and be duplicated when wanted with little loss of time and trouble, and after hardening the chasers may be ground down at the cutting edge until very thin.

B is a cast-iron plate countersunk at *H* to receive and allow *A* to revolve. *F F* are guide pieces to fit the slots of the shaper table. *A* is of cast iron turned and fitted in the plate *B*, and is drilled and countersunk to receive a 7/8-inch bolt. *B* is cored to receive the square head of clamping bolt, as shown. A slot about 1/2 inch wide and 3/8 inch deep is milled in *A* to receive the stock for the chasing



A CHASER CUTTING ATTACHMENT.

tool *C*, which is clamped by the plate *D* and the cap-screws shown. *B* is clamped in position on the table of the shaper and, after setting *A* in position to give the chaser the correct angle by the graduated arc, it is tightened down by the center bolt. This chuck avoids all figuring and laying out.

G. D.

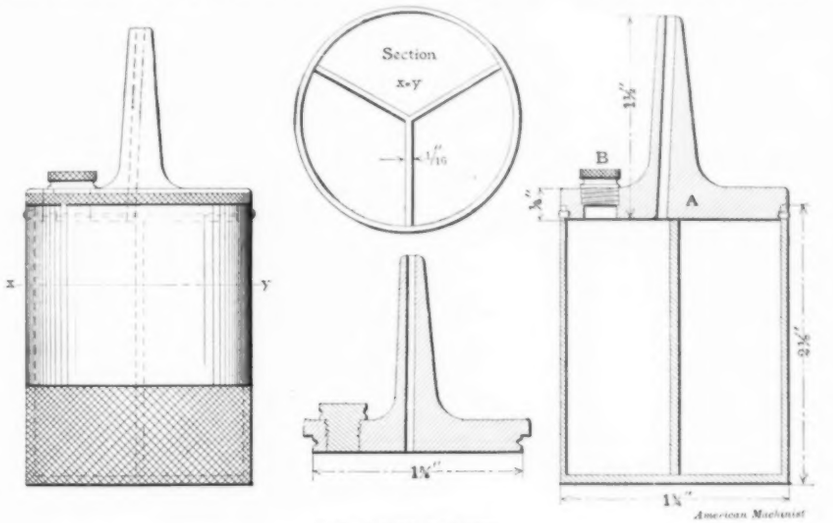
An Emery Shaker.

Editor American Machinist:

Thinking it may be of interest to your readers, I will describe an emery shaker that I designed and found to be a very convenient and useful addition to the toolroom outfit, as it dispenses with the numerous dishes, cans and packages that are generally used to hold the various grades of emery required in lapping and polishing. I made the model from solid brass with three compartments, which I find most suitable for general work, although the device can be divided into six compartments if preferred. The partitions were cut from sheet brass and soldered in place; the body can be made from tubing, but a casting is better. The cap must be a good fit to prevent emery from passing the partitions.

The stem is drilled out of line at the base, to clear the partitions so that by turning the cap *A* each compartment in turn will be free to discharge the emery while the other compartments are closed. Plug *B* can be dispensed with, although it is convenient when refilling, as it saves the trouble of removing the cap.

Outside of the compartments should be stamped the letters F, for fine; M, medium; C, coarse; and the cap should be graduated to indicate when it is in the right position to discharge, or when closed by stopping over partitions.



AN EMERY SHAKER.

EUGENE SEAVEY.

"Thread Milling Cutter Angles."

Editor American Machinist:

We note at page 58 a communication from Mr. E. J. Lees, under the above caption. Your correspondent states that "to be exact, one must have a different cutter for every different diameter of the same pitch."

Like many another statement which gets into print, the foregoing is "important, if true." It can best be analyzed by taking a concrete case which can easily come up in everyday shop practice. For example, take a United States standard screw thread 6 per inch on 1½ inches diameter and the same thread on 6 inches diameter. On the smaller diameter this is a standard thread. On the larger diameter it may easily occur, as on a lathe spindle end. Both threads will be cut with a cutter ground to an angle of 60 degrees for United States standard thread.

The theoretically correct width of cut for this thread, normal to the pitch line, is .14586 inch. The width of cut theoretically produced by a standard cutter set at its proper angle for the pitch on 1½-inch diameter work is .14595117 inch. The cut is too wide by .00009117 inch. In round numbers, the cut is too wide by a "scant" 1-10000 inch. Now, with the same cutter, mill a screw 6 inches diameter. The theoretical width of cut should be, as before, .14586 inch. The width theoretically produced when the cutter head is set at the proper angle for this pitch and diameter

is .1458657 inch. The error in width of cut, not to go too far into decimals, is .0000057 inch, or, in round numbers, 1-200000 inch, "full."

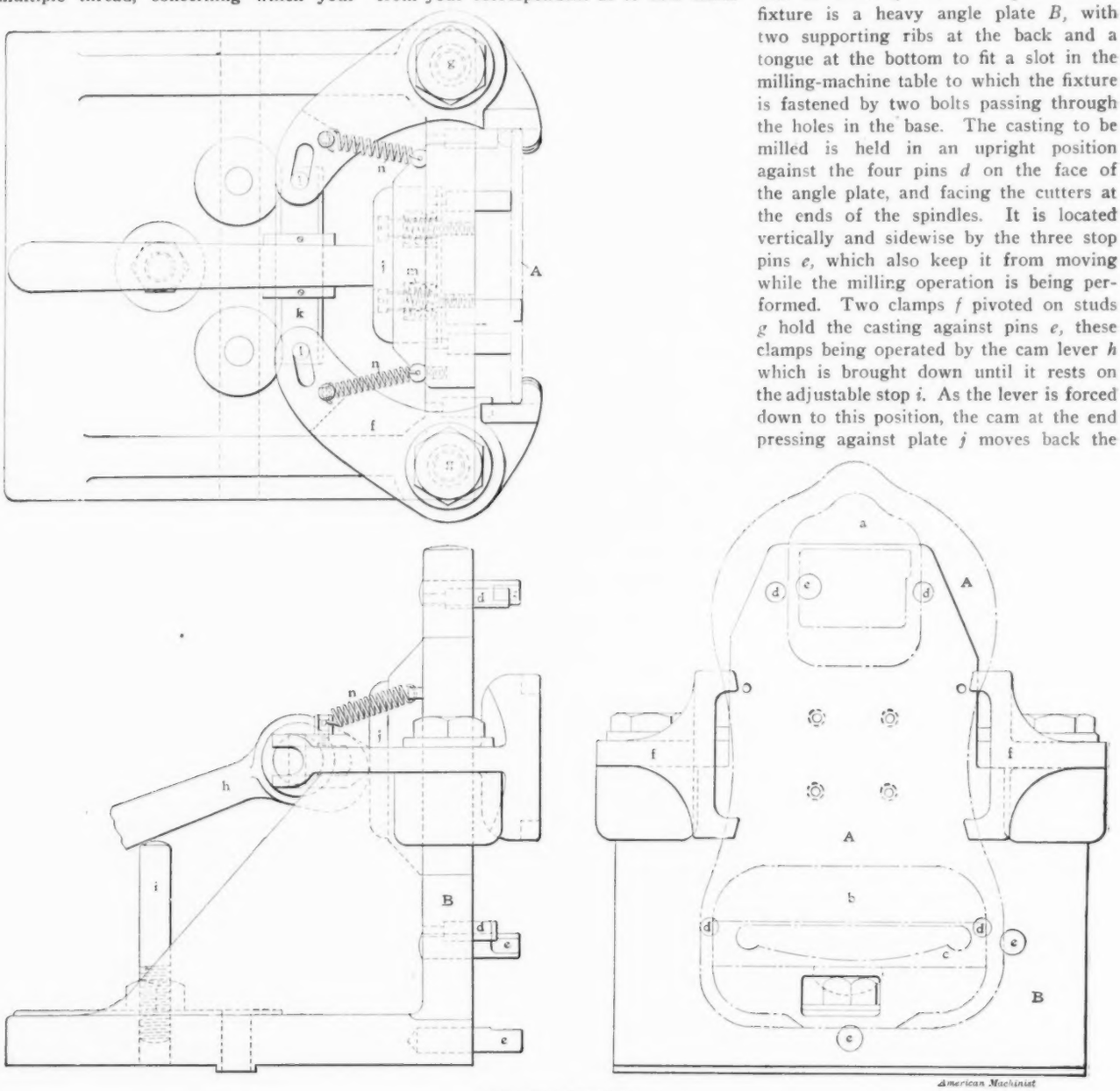
These errors have not yet impressed us sufficiently to lead us to propose the substitution of normal pitch for linear pitch in the specifications of screws when they are to be cut on the thread miller.

As to the correct cutter for a V-shape multiple thread, concerning which your correspondent asks, we would state that in the absence of specifications as to what multiple thread he has in mind, we cannot answer the question except to say that (theoretically again) the cutter should be ground to less than 60-degree angle. How much less depends on the number of threads; your correspondent can doubtless compute this angle for himself, and the automatic cutter grinder we use in connection with the thread miller will enable him to introduce this refinement in grinding. As multiple V-thread taps are something of a rarity in the market, we have not as yet given the matter much consideration. But, in general, a thread miller will enable your correspondent to make such taps, if he must have them, easier than they can be made any other way.

In conclusion, we should like to hear from your correspondent as to how much greater are the errors we herein admit as incident to milling screws with one cutter for one pitch and all diameters, than those made in grinding and setting lathe threading tools.

PRATT & WHITNEY COMPANY.

[As to the last paragraph, perhaps our correspondent uses for "particular" threads the thread tools made by the Pratt & Whitney Company, and which have no error, so far as anybody can discover.—Ed.]



A MILLING FIXTURE.

A Milling Fixture.

Editor American Machinist:

The accompanying drawing shows a fixture for holding the casting represented by dotted lines at *A*, while its two pads *a* and *b* and slot *c* are being milled simultaneously in a double spindle milling machine, the spindles being arranged one above the other and carrying for this work two facing cutters and one end mill. As will be noticed, the main part of the fixture is a heavy angle plate *B*, with two supporting ribs at the back and a tongue at the bottom to fit a slot in the milling-machine table to which the fixture is fastened by two bolts passing through the holes in the base. The casting to be milled is held in an upright position against the four pins *d* on the face of the angle plate, and facing the cutters at the ends of the spindles. It is located vertically and sidewise by the three stop pins *e*, which also keep it from moving while the milling operation is being performed. Two clamps *f* pivoted on studs *g* hold the casting against pins *e*, these clamps being operated by the cam lever *h* which is brought down until it rests on the adjustable stop *i*. As the lever is forced down to this position, the cam at the end pressing against plate *j* moves back the stud *k* on which it swivels, and the pins *l* fastened in *k* and passing through the slots in the ends of the clamping arms *f* swing these clamps out till their other ends are exerting the necessary pressure on the work to hold it while it is being milled. The pressure on the casting may be varied by raising and lowering the stop *i*, thereby increasing or decreasing the movement of cam lever *h*. In order that the fixture may automatically compensate

for and hold equally well and without springing castings which are buckled or have slight variations in thickness, cam lever *h* instead of bearing directly against a solid casting, exerts itself against the round cap *j*, which fits in the back of the angle plate and is supported by four stiff springs *m*. These fit in four pockets in the back of the round plate, and the latter is attached loosely to the angle plate with four screws passing through the springs. Thus it will be seen that the pressure exerted on the casting to be milled is applied by stiff springs and is not inflexible. The casting is clamped in the fixture or released by one movement of the lever *h*, the two springs *n* swinging the clamp jaws around when released by the cam, leaving the working face of the angle plate clear while the milled casting is removed and another put in its place.

H. ROBINSON.

A Few Hints for the Draftsman.

Editor American Machinist:

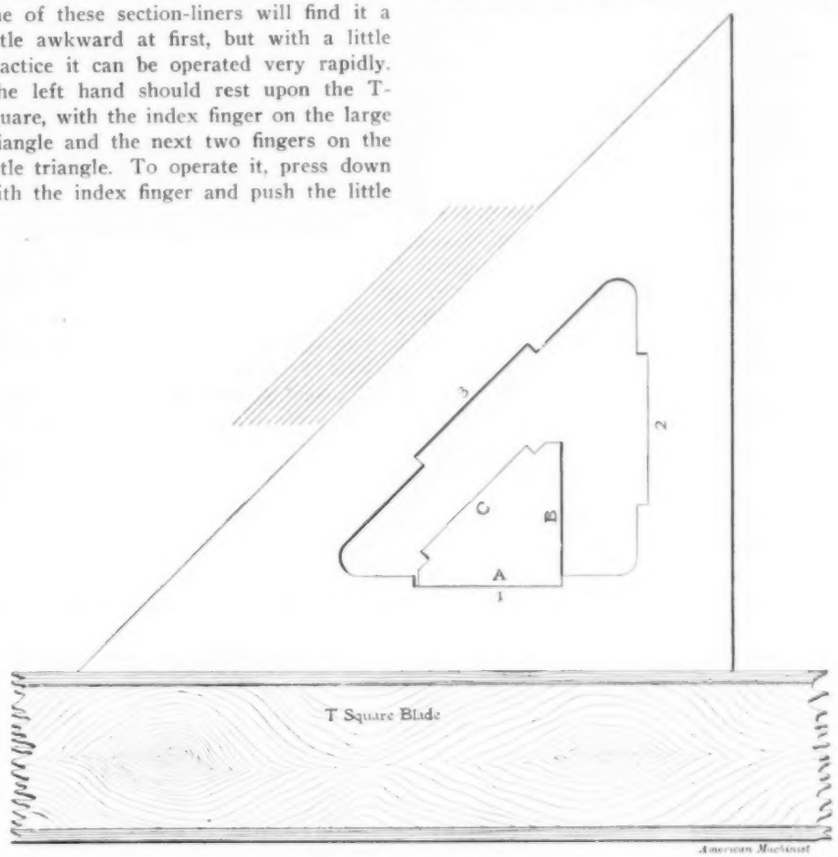
These hints may seem very simple to old draftsmen, but we must not forget that there are a great many young draftsmen who enter the field every year, and they have all to learn the same as we did. I have heard draftsmen say, when they saw some article in a mechanical paper: "That is old," or "I knew that years ago," which may be true, but there are hundreds of others that do not know it, and nobody compels those that do know it to read it, as there are other articles in the same paper that they probably know nothing about.

Many tracings are almost ruined by erasing lead pencil or crayon marks with a pencil eraser. This destroys the finish on the cloth and the injured places become soiled and show on the blueprint. By using a piece of soft cloth and a little benzine the marks may all be removed from the tracing, no matter how badly it may be marked with the colored crayons or black lead pencil. With gentle use the benzine will not injure the ink lines nor the finish on the tracing cloth. Its inflammability is the only objection to its use; but there is a very convenient small galvanized iron can, with a spring valve in the spout, on the market, which is nearly fireproof. This method is in use in one of the largest drafting offices in Chicago, where they have sixteen or eighteen cans. The duty has been assigned to one of the office boys to collect these cans every night, take them down to the basement and lock them in a place for safe keeping, and in the morning return them again to their respective places.

Another useful kink is a method of keeping the ink from running on a tracing after rubbing out a lot of work which must be redrawn. After finishing the rubbing out, take a stick of soap-stone, scrape a little of it over the surface that has been rubbed, and with a rounded stick burnish the tracing, which will leave a nice, smooth surface on which the ink will not run.

The accompanying sketch shows a good practical section-liner which any boy or man with any mechanical ability can make. The little triangle in the center can be made of a piece of an old triangle or of a thin piece of wood. The length of notch 1 should be about 1.54; of 2, about 1.57, and of 3, about 1.60 inches. The length of *A* on the little triangle should be about 1.53; of *B*, about 1.52, and of *C*, about 1.51 inches, giving nine steps from one one-hundredth to nine one-hundredths inch, in steps of one one-hundredth inch. This makes quite a variety, but it can be doubled by making two small triangles instead of one. Those who have never used one of these section-liners will find it a little awkward at first, but with a little practice it can be operated very rapidly. The left hand should rest upon the T-square, with the index finger on the large triangle and the next two fingers on the little triangle. To operate it, press down with the index finger and push the little triangle along to the right-hand end of the groove in the large triangle, with the other two fingers; then press down on the little triangle and push the large triangle to the right until it stops against the small triangle, repeating this as the work proceeds. With a little practice it can be operated faster than the ruling pen. One advantage this section-liner has over others is that it is always set and ready for use. In case of an old drawing requiring some changes, the section lining can be exactly duplicated, while with an adjustable section-liner considerable time would be wasted in adjusting it to agree with the section lining on the drawing.

WALTER BROWN.



A SIMPLE SECTION LINER.

The Inventor of the Link Motion.

Editor American Machinist:

In the wonderfully interesting article which you publish at page 178 on "Who Really Invented the Link Motion?" I am quoted as one of the historical writers who have wrongly attributed the invention of the link motion to William Howe. Until you published the article in which Ralph Little Whyte is represented as giving credit to the real inventor, Williams, the world had no reason to doubt the evidence of Clark, Colburn and other early writers about the locomotive, that Howe's claims to be the real inventor were well founded. Like others, I was familiar with the arrangement in your Fig. 1 as being the contribution that Williams made to the invention of the link motion, and it needed no engineering discrimination to see that the device was impracticable. I always thought it very strange that the man who had the genius to propose using the link as a reversing motion should have had so little designing skill as to propose applying the link so close to the eccentric straps that it would not work, and I am pleased to learn that such a scheme had never been entertained by the inventor.

In my future writings, and in my forthcoming book on "The Growth of the Locomotive," I will certainly do all in my power to accord justice to Williams as the real inventor of the link motion.

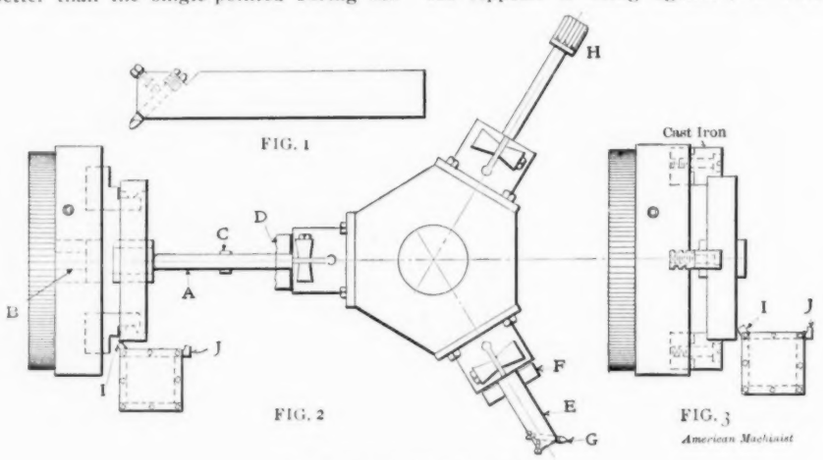
New York. ANGUS SINCLAIR.

Machining Gear Blanks.

Editor American Machinist:

I have read the article by Mr. Kleinhans at page 121 on "Machining Gear Blanks" and enclose sketches showing what I regard as a better way. *A*, Fig. 2, is a roughing bar supported by a bush in the headstock. When the cutter *C* has passed through the hub the corrugated cutter *D* is fed up to rough off the face of the hub. In the meantime tool *I* has roughed off the outside of the rim, being made with a double lip for facing as well as turning. Boring bar *E*, shown to larger scale in Fig. 1, is now brought into position and does its work while the finishing tool *J* takes the finishing cut. This tool also has double cutting edges, as shown. Boring bar *F* having passed through the hub, the finishing cutter *F* faces the side of the hub.

For the second side all standard turret lathes are fitted with universal chucks similar to Fig. 3, having soft jaws that can be bored to fit the blanks by chucking something firm in the smaller diameter of the jaws. The blanks are inserted as shown and tightened, when the roughing bar *A*, Fig. 2, is again brought to position and fed to cutter *D* while tool *I* in the turret post roughs off the rim. Tool *J* finishes the rim while cutter *F* is run to a stop on hub. Reamer *H* with a floating shank reams the hole, and the job is finished in less time, more accurately and with about one-tenth the cost of Mr. Kleinhans' equipment. His drilling attachment is without doubt good on jobs having long hubs to bore, but on gear blanks it would lead to no advantage because it takes longer to turn and face the rim than to bore the hole. So far as boring true holes is concerned, nothing does better than the single-pointed boring bar



MACHINING GEAR BLANKS.

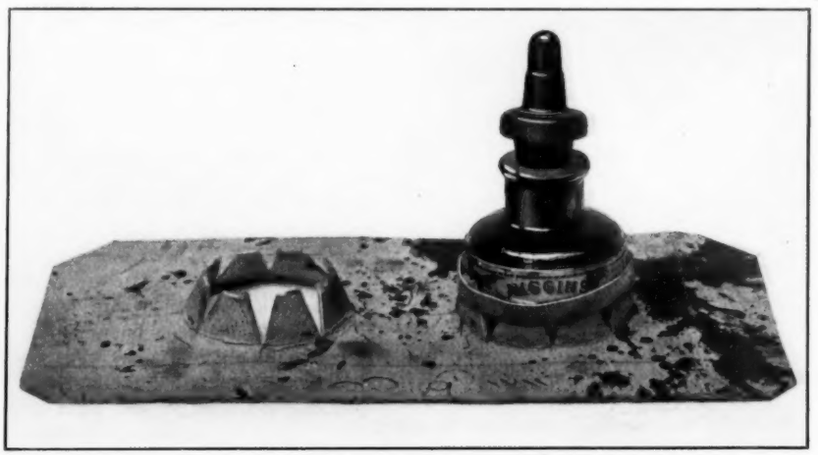
Fig. 1 for the final boring before reaming. I must also take exception to his plan of allowing the four-lipped drill to take its course in roughing the hole. I do not consider his method of driving the blank in doing the second side solid enough to prevent chattering even if he could hold it as claimed. Finally he shows no way to turn the rim.

That some jobs can be done as rapidly and as well on a plain as on a turret lathe I heartily agree to, but certainly not gear blanks. SCRIBLETS.

An Inexpensive Ink Bottle Holder.

Editor American Machinist:

I notice at page 24 a letter on "Ink Bottle Holders." They are all right in a way, and if furnished by the concern which employs you; but if you want a good holder that can be made in about two minutes, look at the cardboard affair enclosed. This is made for a Higgins bottle. Just slip the bottle in and bind the flaps to it with a rubber band. HERMAN JONSON.



AN INEXPENSIVE INK BOTTLE HOLDER.

For an Engineer Judge.

Editor American Machinist:

Now that the matter of a Court of Patent Appeals is being agitated, it would seem seasonable to advocate the appointment of an engineer of scientific learning and mature experience as one of the judges. The want of some such provision as now contemplated has been felt almost from the inception of our patent laws, and has been recognized by Congress and the courts. With every year engineering knowledge becomes more complex, and the demand that engineering questions shall be considered by an engineer becomes more imperative. E. J. STODDARD.

Weight of Fillets.

Editor American Machinist:

In order to facilitate the calculations of the weights of the different parts of a machine from the drawings, I have prepared the accompanying table of areas or volumes of fillets having radii from 1-16 to 3 inches. It has been calculated for fillets connecting sides that are at right angles to each other.

Radius of fillet in inches.	Area or volume of fillet in sq. or cubic inches.	Radius of fillet in inches.	Area or volume of fillet in sq. or cubic inches.
1/16	.0008	1 9/16	.5240
1/8	.0033	1 5/8	.5667
3/16	.0075	1 11/16	.6119
1/4	.0134	1 3/4	.6572
5/16	.0209	1 13/16	.7050
3/8	.0302	1 7/8	.7543
7/16	.0410	1 15/16	.8056
1/2	.0537	2	.8584
9/16	.0678	2 1/16	.9129
5/8	.0838	2 1/8	.9690
11/16	.1013	2 3/16	1.0269
3/4	.1207	2 1/4	1.0864
13/16	.1417	2 5/16	1.1475
7/8	.1643	2 3/8	1.2105
15/16	.1886	2 7/16	1.2749
1	.2146	2 1/2	1.3413
1 1/16	.2423	2 9/16	1.4086
1 1/8	.2716	2 5/8	1.4787
1 3/16	.3026	2 11/16	1.5500
1 1/4	.3353	2 3/4	1.6229
1 5/16	.3697	2 13/16	1.6869
1 3/8	.4057	2 7/8	1.7739
1 7/16	.4434	2 15/16	1.8518
1 1/2	.4829	3	1.9314

TABLE OF AREAS OR VOLUMES OF FILLETS.

To find the volume of a fillet by this table when the radius and length are given, multiply the value in the table opposite the given radius by the length of the fillet in inches, and this result multiplied by the weight of a cubic inch of the material will give the weight of the fillet.

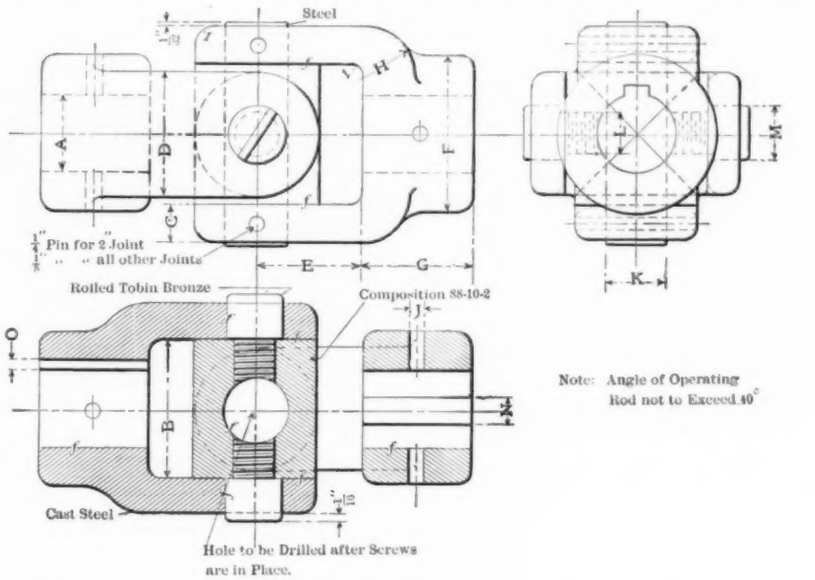
BENJ. BROWNSTEIN.

Universal Joints.

Editor American Machinist:

As occasions for using universal joints frequently arise in the work upon which I am generally employed, and as I am always on the lookout for any new ideas that may be of assistance, the different types of joints that have been published from time to time have been of some interest.

In the piping systems of ships it is often necessary to locate a valve in a compartment that is not of ready access, or to provide for operating the valve from the deck above when it is located in a compartment that by an accident may be flooded by water or by steam from a bursted steam pipe. The accompanying plan and


Steel
Pin for 2 Joint
" " all other Joints
Rolled Tobin Bronze
Composition 88-10-2
Cast Steel
Hole to be Drilled after Screws are in Place.
Note: Angle of Operating Rod not to Exceed 40°

Diam. of Shaft	Jaws								Pins		Screws		Key Ways
	Distance between	Thickness	Width	Length	Diam. of Hub	Length of Hub	Radl.	Corners and Fillets	Diam.	Diam.	Diam.	Diam.	
A	B	C	D	E	F	G	H	I	J	K	L	M	
$\frac{5}{8}$	$1\frac{1}{8}$	$\frac{5}{16}$	1	$\frac{15}{16}$	$1\frac{1}{8}$	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{5}{32}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{4}\times\frac{1}{8}$
$\frac{3}{4}$	$1\frac{3}{8}$	$\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{32}\times\frac{1}{8}$
1	$1\frac{3}{4}$	$\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{9}{16}$	$1\frac{7}{8}$	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{5}{16}\times\frac{1}{8}$
$1\frac{1}{4}$	$1\frac{15}{16}$	$\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{1}{8}$	$1\frac{3}{4}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{8}\times\frac{5}{32}$
$1\frac{1}{2}$	$2\frac{1}{8}$	$\frac{5}{8}$	2	$1\frac{7}{8}$	$2\frac{1}{2}$	$1\frac{7}{8}$	$\frac{3}{4}$	$\frac{5}{16}$	$\frac{1}{4}$	1	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{15}{32}\times\frac{5}{32}$
$1\frac{3}{4}$	$2\frac{1}{2}$	$\frac{5}{8}$	$2\frac{1}{4}$	2	$2\frac{3}{4}$	2	$\frac{3}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$1\frac{1}{8}$	$\frac{3}{4}$	1	$\frac{7}{16}\times\frac{3}{16}$
2	$2\frac{5}{8}$	$\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{1}{2}$	3	2	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$1\frac{1}{4}$	$\frac{7}{8}$	1	$\frac{1}{2}\times\frac{3}{16}$

American Machinist

UNIVERSAL JOINTS.

table of dimensions of universal joints show the type usually employed for such cases in piping arrangements of ships.

A. H. NOURSE.

Forging a Three-Way Plug.

Editor American Machinist:

We had an old-fashioned steam riveter which was operated by a three-way cock, a wrought-iron lever being attached to a square shank on the big end of the plug. This cock was of brass, and the boys had the misfortune to blow out the plug and break out the partition between two of the slots. Now, this machine was always run to its full capacity and was always behind with its work, and as the output of the whole shop depended on this machine it was very necessary to get it going again as soon as possible. It would have taken a week to get a new cock from the factory so it was decided to forge out a new plug and fit it there. To forge one out solid is not much of a job, but when the superintendent came and asked me if I could punch the slots to help them out on the job it was a poser for me at first, but I told him I would do the best I could.

I took a piece of soft steel about ½ inch larger than the largest finished portion of the plug and squared up the top part for the hand lever, fitting it to the square hole and leaving this part about 6 inches long so that it could be handled easily with the tongs. The next move was to taper the main portion, and I was then ready for the punching of the slots. It would have been no trouble to punch one slot clear through, but after a little thought I saw my way clear to punch the other also and do a nice job. Getting rid of as much stock as possible before punching the holes, I took a ½-inch gouge and gouged a section on opposite sides and one at right angles, as shown by the dotted lines in Fig. 1. I next sunk a punch about the right size of the slot, down to and a little past where the near side of the through slot would come, working it flatwise from

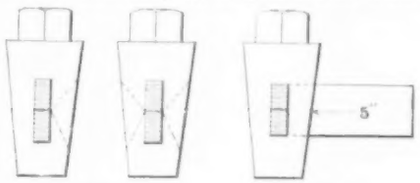


FIG. 1 FIG. 2

American Machinist

FORGING A THREE-WAY PLUG.

side to side so that the bottom part would be larger than the outside. Next I took a piece of ⅝x2-inch iron, got a short, hot heat on it and sunk it in this slot so that it would stick there tight, as in Fig. 2. This gave a foundation to punch the through slot, which I proceeded to do, first sinking a thin chisel down to the plug so as to give as little resistance as possible when punching out the rest of the hole. The plan worked like a charm, and after driving a drift in the slots to size the holes and swaging down smooth and nice outside, I had an excellent job. The lower portion was next finished and cutting the top the right length for the hand lever all the machinist had to do was to turn the taper and grind to the seat. Six hours after the valve broke, the machine was in operation again as good as ever. This was one way of helping out in a pinch, and it was appreciated, too.

There are many things also wherein a machinist can help the smith if he is not too particular and grouchy. It happens at times that a hole, if drilled instead of punched, will make a neater job and a quicker one for the smith, and while I have generally had the work done, I have at times struck a man who would refuse to do it or make all kinds of excuses—"too busy just then"—and do half a dozen jobs before he would do mine.

T. FOOT.

Profiling Fixtures and Formers.

Editor American Machinist:

I read with much interest an article at page 1694, Vol. 26, on the making of profiler formers. I notice, however, in the last of the article Mr. Rowe states that where a machine has but one pin for each spindle he scribes his form and finishes by hand.

I have had several sets of formers made for machines of this type. I mill a slot at right angles to the cross-rail in the platen—usually milling this with an end mill in the spindle of profiler—then fit a tongue to the base of the fixture to suit the slot in the platen; the fixture can then be easily reversed and the form milled as easily as on a machine with two guide-pin sockets for each spindle. LEROY TABOR.

Compound Die and Punch.

Editor American Machinist:

Figs. 2 and 3 show a compound die and punch for cutting out sections for a large circular disk forming an armature unit. The blank, Fig. 1, is approximately 28x $7x_{3}^{1}{}_{2}$ inch with two round holes and dovetail cutouts. The large size of the blank rendered it impracticable to make either the punch or the die in a single piece.

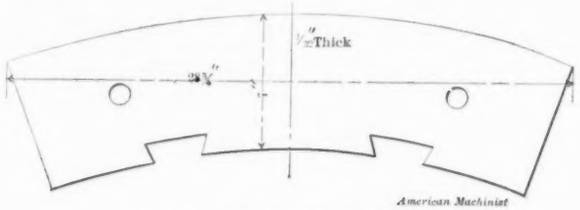


FIG. 1. THE BLANK TO BE CUT.

Fig. 3, although the upper piece, is the die, and is fastened to the bottom of the ram. It comprises a cast-iron holder 1, steel die sections 2, fitting nicely and tightly together in the holder, to which they are fastened with screws 3, two small punches 4, stripper 5 and pins and springs 6 and 7.

The punch, Fig. 2, is the bottom part, and is fastened to the bed of the press when in position. It also has a cast-iron holder 1 fitted and fastened to its steel sections 2 by screws 3; also two small dies 4, and stripper 5, held in place by pins and springs 6 and 7.

Fig. 4 shows the inner punches and dies for the round holes, and the way they are held in the main punch and die.

When the ram of the press comes down, with the punch and die fastened in position, the blank, Fig. 1, is cut out between the cutting edges of the die and punch, also the holes in it by the round punches and dies fastened in the main punch and die. The blank is forced into the inside of the die, and when the die goes up the stripper 5 inside the die forces the blank out, and it falls on the face of the punch. The waste material around the punch, Fig. 2, is also forced upwards by its stripper 5, prompted by the springs and pins 6 and 7, as shown at *X*, section *A A;* and the blank and waste lie loosely on the top of the punch and are removed easily by hand.

H. ROBINSON.

Starting a Toolroom.

Editor American Machinist:

The shop here described had, from a very small beginning, grown to one employing seventy-five to one hundred men. With its growth the special tools, jigs and templets had greatly multiplied, and nothing had been done to supply a place for them. Consequently, they were scattered around the plant in cupboards, on and under the benches, hanging on the walls, in the bench drawers and in the workmen's tool boxes; in fact, they were everywhere and were impossible to find when wanted.

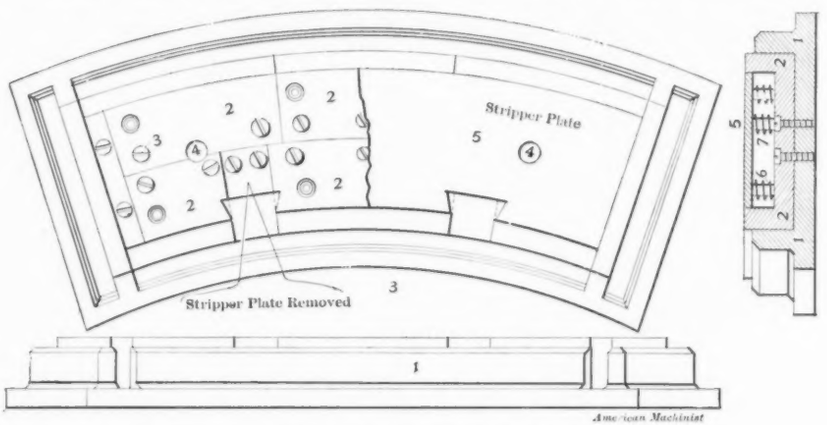


FIG. 3. UPPER PART OR DIE.

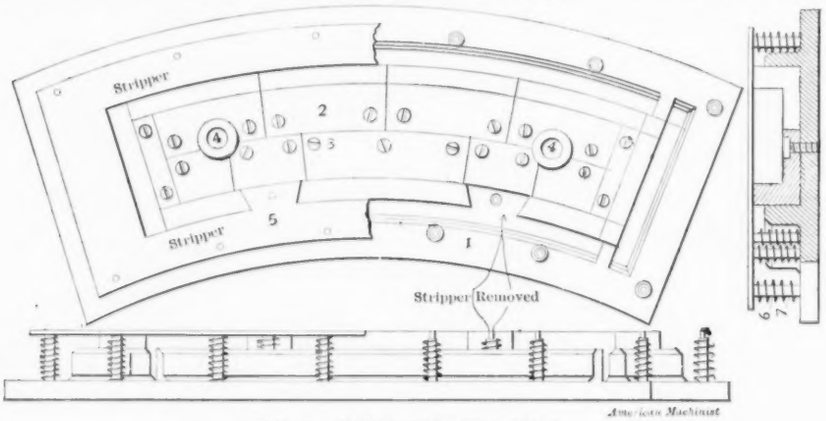


FIG. 2. LOWER PART OR PUNCH.

Every lathe and planer—in fact, every machine in the plant—had from three to five times as many tools as required. Each drill press was supplied with an outfit of drills and sockets supposed to be complete, which, however, did not prevent constant borrowing of tools, with much loss of time and great confusion.

The drill press operators did their own drill grinding, using a twist drill grinder when convenient or when the crowd around it was not too great, in which case the grindstone was used. The collection of lathe and planer tools had grown to such an extent that it caused much loss of time to find the particular one wanted, resulting often in a trip to the tool-dresser rather than a longer hunt. This caused a waiting crowd in the blacksmith shop, and often a dispute as to who was "next." The loss caused by this cannot be given accurately, but it amounted to the entire time of from two to three men. One tool-dresser and his helper were constantly employed in dressing tools alone, new tools often having to be made by another man.

Scattered throughout the shops were work benches to accommodate twenty-six workmen. In the drawers and scattered on the benches were several hundred files of various sizes, more than half of them less than half and many of them but little worn. Cold chisels and drift punches were in still greater numbers, and with their heads broken and battered until they resembled mushrooms more than chisels. Monkey-wrenches and drop-forged steel wrenches were numerous and in various conditions. Under the benches (that convenient place for storing things) were castings, old files, broken bolts, bolts with the threads stripped, blocks of wood, split file handles, old overalls, old shoes, cotton waste, babbitt metal, scrap brass, worn-out lunch pails and oil cans, pieces of cold rolled key stock and shafting and parts of the various machines manufactured that had been broken or otherwise spoiled and had mysteriously disappeared.

Throughout the machine shop these conditions existed, and, to make things worse, the line shafting ran but 110 revolutions per minute. A low-speed line shaft does not necessarily imply slow-running tools, nor would it, perhaps, affect all men alike, but to some it has a depressing effect and creates a tired, want-to-stop feeling that retards production.

The boiler shop was in better shape. The storehouse—or warehouse, as it was called—was across the street, and therefore was not "handy," and when material such as rivets, angle iron, etc., arrived, it was found more convenient to put it at once on the shop floor. As there was no fixed rule in the matter, such material would sometimes go to one place and sometimes another. No one knew what was in stock. Consequently much material was bought which was already on hand. Supplies and stock for the whole plant were handled in this way.

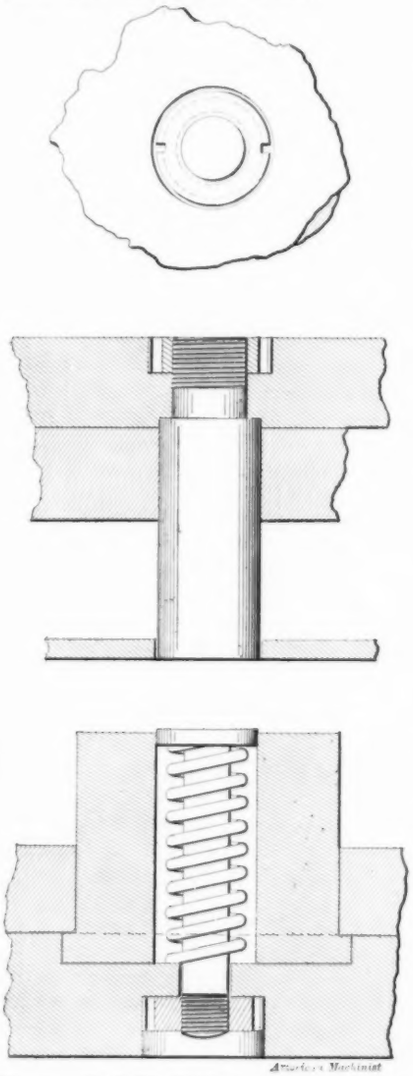


FIG. 4. SHOWING SMALL PUNCH AND DIE.

To some this description may seem overdrawn, but, in fact, conditions were even worse than described. The men had fallen into careless, slovenly habits. Having no fixed place for things they made a place by dropping the thing used on the floor or in whatever spot was most convenient.

During the fat years of business when orders were plenty and prices high, this plant could make some profit, but when the lean years came, business could not be done profitably without cutting wages. The establishment of order and system required, first, a good toolroom and a storeroom. With these finished and ready to receive tools and goods, a beginning could be made. The machine shop was two stories high, and the adjoining boiler shop, one. An addition was built in the angle between the shop and boiler-room with a second story extending over the boiler shop. The toolroom, 30x40 feet, occupied the first floor space in the angle and the entire second floor, 30x70 feet, was made into a storeroom. The toolroom was equipped with the necessary machines, including a twist drill grinder and a lathe tool grinder. When the rooms were completed a systematic clean up was commenced and continued until all tools, jigs, templets, etc., were arranged in the toolroom and all supplies and stock found scattered around were collected in the storeroom. All surplus lathe, shaper and planer tools were sent to the blacksmith shop, and after dressing to proper shapes were sent to the toolroom. Twist drills and sockets were sent to the toolroom where the drills were properly ground and issued on check only. Every piece of casting or other material that was not wanted for completing orders on hand was removed from the shop. In fact, every piece of dead material was cleaned out.

What saving this system and order effected per year over the old way cannot be given exactly in dollars, but we can mention enough items to show that it was well worth the expense. The time saved in dressing and in waiting for tools to be dressed was equal to the entire time of two men at $2.50 per day, making $30 per week, or $1,560 per year. This may seem an extravagant statement, but the tool dresser and his helper had been kept busy all the time on tools, while after the surplus tools were fixed up and sent to the toolroom fully one-half their time was given to other work. The money lost by the lathes or planers being idle while tool dressing was being done was greater or less according to the value of the idle tool. If the above figures are wrong, they are too low. One item of expense, files, was reduced by one-half. That for tool steel during the first year was wiped out except for the cost of a few bars of self-hardening steel. This, of course, was due to the large amount of surplus steel collected from the various tools.

Aside from the financial gain the effect of law and order had a great influence as a spur or stimulant to every man and boy in the shop. Slovenly habits gradually disappeared. The appearance of things, including that of the line shaft which was speeded up, no longer exerted a depressing effect. B. W. T.

Steam for Heating.

Editor American Machinist:

I find the following in the *Pacific Coast Miner*, and it provokes a question as to its correctness:

"There are cases where steam is used direct from the boilers for heating purposes and where the question comes up whether to use a cheap boiler which will make wet steam or a highly efficient boiler which will make very dry steam. In ordinary work, for use with an engine, the latter is, of course, the one to be chosen; but where all the steam is to be used for heating, the cheap boiler that makes wet steam is the better."

As I understand it, all steam which is not superheated is as wet as it can be, or is saturated steam. As soon as such steam leaves the boiler it begins to cool, and by this same operation of cooling some of it ceases to be steam and becomes water again. We then have "wet" steam as commonly understood, or dry steam or real steam mixed with water. As the steam goes along doing its heating or giving up its heat, more and more of it successively reverts to water, until at last we have all water and no steam, and then in a steam-heating system practically no more heating is done.

It seems to me that the boiler which for a given weight of fuel will put the most heat into the water, or which will convert the greatest weight of water into steam, is the boiler we want, either for heating or for any other use of steam. The boiler which sends out water with its steam, or which "makes wet steam," as we say it, is engaged in a two-fold operation. It is making and sending out steam which is wanted and sending with it water which is not wanted, the latter not necessarily in evidence of defective heat-generating or heat-imparting capacity, but simply of improper circulation. The fact remains that all through a steam-heating system from the very beginning it is steam and not water that we want, and at the end of the system for any given amount of heating effected, the smaller the quantity of water discharged the better, because at whatever temperature the water is discharged the difference between that temperature and the normal is so far a dead loss, and the greater the quantity of water discharged the greater the loss. I think, therefore, that the boiler which sends out only steam and no water is the one which I would choose every time for steam heating. MORRIS FULTON.

Split Nuts for Use in Driving Threaded Work.

Editor American Machinist:

At page 153 "Cherry Red" shows a driver for threaded work which is an improvement on one previously shown. An objection to a driver of this kind is the waste of time in screwing the driver on and off the work.

While it is not the intention to criticise the device shown, I believe our old friend, the split nut, is preferable to anything in this line that has been shown as yet, on account of the convenience and rapidity with which it may be applied to the work.

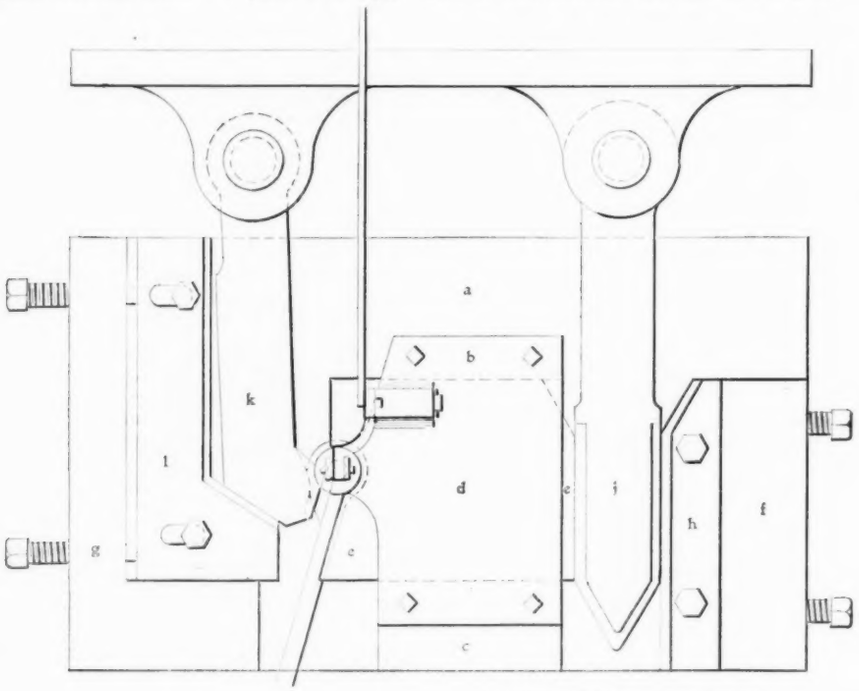
A set of nuts from 3/8 to 1 inch take up very little space in one's tool box when kept in a wooden block with a series of holes to suit the different sizes. The corners should be turned off until the nuts are round; they can then be sawed in half, case-hardened, and used in connection with an ordinary lathe dog. C. S.

Die for Turning Eye Bolts.

Editor American Machinist:

The accompanying sketch shows an eye-bolt bender for the bulldozer or header. We found ourselves in a position where we had to bend about 9,000 11-16 inch eyes of 5/8 stock per season, and the die shown does the work with an increased output of about 300 per cent.

At *a* is the body of the die and at *b* and *c* are projections from its face, their inner edges and tops being planed, as was the space between them. A plate *d* bridges



DIE FOR TURNING EYE BOLTS.

over *b* and *c* and a tool-steel slide *e* shaped on one end to fit one side of the eye and on the other left straight, except the beveling of one corner as shown, fits the space between *b*, *c* and *d*. At *f* and *g* are two additional projections and at *h* is a jaw fitted with a hardened steel face held down with two 1/2-inch cap-screws and fitted with two adjusting screws, as shown. The pin *i*, around which the eye is formed, is arranged to be withdrawn during the back stroke of the bulldozer. It is made of tool steel and is hardened, as is the bushing in the plate *d*. To turn different sizes of eyes we make suitable slides, pins and bushings.

The stock is entered at the right of pin *i* to a gage and the ram *j* enters between jaw *h* and slide *e* and, of course, forces the latter toward the pin and partly forms the eye, leaving the surplus stock sticking out in a horizontal position, when the tool-steel ram *k* completes the turning by engaging with the incline on piece *l*.

We bend about 4,000 1-inch eyes of 5-16 inch stock cold per day of nine hours.

GEO. J. HALEY.

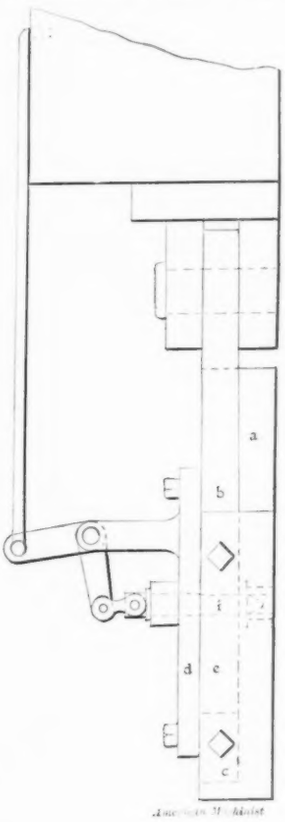
Robinson's Mill Experience with an Amateur Engine Fixer.

Editor American Machinist:

Mr. Suverkrop's article at page 1834, Vol. 26, wherein he tied up the valve stem with a wire and fixed the engine in a few minutes so that it would keep going, shows how the man who has had emergency experience is sometimes able to get out of a tight place and keep going under conditions where it would at first seem impossible.

This recalls an experience in Robinson's mill. Robinson had the only Corliss engine in that section. He had had a grist mill there for a long time, and, as in many other pioneer industries, it took a good many years of hard work and close economy before he blossomed out with a real Corliss engine, and no boy with new boots ever felt more pleasure in wading in the snow than Robinson did when that mass of polished steel and brass began to turn over and drive the mill. The boys in the shop used to say that Robinson thought more of that engine than he did of his wife or his best horses (which was saying a good deal, because he was fond of horses). I don't know whether this was correct or not, but I do know that he used to sit up nights with this engine while he directed the men how to pry the flywheel back and forth into various positions, while he set the valve "by the book" which came with the engine. On one occasion this lasted for forty-eight hours without any stop, Robinson paying for two of the best men in Jones' shop to "assist" him. One of these men (George we will call him) was about the only man in the shop that Jones had any confidence in. George used to remonstrate with Jones about all this "foolishness" that Robinson made him go through with on that engine, but Jones, who had argued mechanical points with Robinson on several occasions, had come to the very wise conclusion that as Robinson was able and willing to pay all the bills, the only thing left was for George to do it the way Robinson wanted it done.

Well, one day, several years after the engine had been installed, Robinson sent



word to have someone come over to the mill quick, there was something wrong with the governor. Jones went right over himself, and, sure enough, that engine which had always been gentle and steady was on the rampage. She would sulk along until she got down to little over half speed; then she would take the bit in her teeth and go faster and faster, until it seemed as if she had made up her mind that she had run that old mill long enough and was either going to shake it off or lie down and quit. She kept repeating this performance about once a minute. "It's all in the way you adjust this bolt," said Robinson, who pointed with the monkey-wrench to a bolt just below the arms on the governor. "I have got it better than it was, but it is not quite right yet." As I remember it now, that bolt went through two lugs and, I think, held up the sus-

pended weight and also connected some other arm or lever; at any rate, it should have been shouldered so that when the nut was tightened it would not clamp the lugs; but, as it was, if the nut was drawn up tight it would lock the governor so that it could not move. Jones examined the bolt, while Robinson told him just how much friction there ought to be on that nut. Jones told him there ought not to be any friction on it, and if there was any the less there was the better. To prove it he ran the nut away from the lug an eighth of an inch, and the engine ran somewhat better, but still kept "hunting" badly.

Robinson still insisted on his theory and finally Jones told Robinson what he thought of his knowledge of mechanics in general, and Robinson expressed his opinion of a machine-shop proprietor who could not adjust a nut on a governor. Things were getting interesting when Robinson was called away to see something over at the sawmill. The head miller, the engineer, and the fireman, who had been interested spectators, all went out to other parts of the mill and left Jones alone with the engine, which was still jogging along making bad flour. Jones examined the governor for twenty minutes and saw nothing wrong with it, except that it would not govern. There was nothing about it to get out of order, so he began to look around. He noticed that one steam valve would pick up every time, while the other one only did so at intervals. He made up his mind that the small cam on the end of the valve stem had got worn too much; but how was he going to prove it? Then an inspiration struck him. On a work-bench nearby he found some strips of tin and he held one of these so that the end of it rested on the cam, thus practically lengthening the cam the thickness of the piece of tin. As soon as he did this the engine steadied up as though it had never known any bad habits. When he removed the tin the engine ran wild again. Having demonstrated to his own satisfaction that he had solved the problem, he called the head miller and showed him where the trouble was. "Oh," said the miller, "we will fix that," and, taking the strip of tin, he twisted the ends around the casting which carried the valve stem and so kept the tin in place. Jones told Robinson what the trouble was and advised him to put some new cams on at once. Robinson said he would see about it. Three months later Jones dropped in to see the mill and found the engineer was still renewing the pieces of tin.

Once Jones got a chance at that engine when Robinson was away. One morning he found that one of the exhaust valves had broken square off and twisted the stem. As quickly as possible he made a rough pattern, cast the valve that afternoon, fitted it up in the night, and by noon next day had things ready to put together. Jones had a line run along the cut-off edge of the valve and across the end of it, and as the engine already had a line on it to show where the edge of the port was, Jones just slipped the valve in, set the crosshead so that it was 2½ inches from the end of its travel (the engine was 40 inch stroke) coupled up the valve gear, turned the engine over once, and told Pat, the engineer, to go ahead. Pat gasped, "But you haven't set the valve." "Yes, I have; the valve is all right, you go ahead." "Never a bit will I do it. It takes half a day to set one of these valves. I have done it too often. You want to get us all killed?" And he wouldn't start it; so Jones had to start it himself, and it was only when Pat saw that Jones's men had gathered up their tools and were leaving that he gathered sufficient courage to come back into the engine-room.

There are others besides Pat who think things must always be done in the same old way, and there are others besides Robinson who lose a lot of money because they think they know something about mechanics. TIMOTHY BROWN.

Silver Circles for Surveying and Astronomical Instruments.

Editor American Machinist:

In all the best class of instruments for surveying and astronomical purposes having circles for the reading of angles in azimuth or altitude the dividing of the circles is generally done on silver, which is undoubtedly one of the best of metals for this purpose, being easily soldered, bent, turned or filed. In these instruments the circles are generally made of brass or gunmetal; the silver is dovetailed in where the divisions are required, and this article is intended to show the methods used.

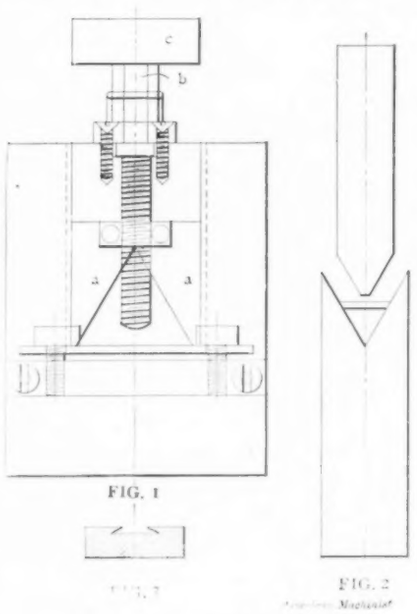


FIG. 1

FIG. 2

PREPARING SILVER CIRCLES.

The silver, as it comes from the rolling mills, is generally about 5 feet long, 1 foot wide and 1-32 inch thick. If it is required to silver a circle of, say, 6 inches diameter and the face of the silver is to be ¼ inch wide, we cut with the shears a strip 5-16 of an inch wide and about 19½ inches long. Fig. 1 shows a cutter for beveling the edges. Filing bevels ½ inch long on one end, the strip is entered in the device and drawn through, the cutters *a* being fed down after each pass by the screw *b* and knurled head *c* until we have a complete bevel on both edges, the narrow face being about ¼ inch broad.

The silver is then heated to a dull red heat and allowed to cool, when it will be found to be quite soft. With the punch and die, Fig. 2, the latter held in a vise, the silver strip placed broad side uppermost is bent to a horseshoe section, care being taken to keep it as free from kinks as possible. It is then annealed again and is ready to be fixed in the circle, which has a groove turned in it as shown in Fig. 3, the bevel or angles agreeing with the cutter, Fig. 1. One end of the strip is filed square and laid in the groove and with a light flat-faced hammer it is hammered in place. Being soft and narrower than the groove before being hammered, there will be no difficulty in bending it to the curve of the circle. After being hammered lightly in up to the last half inch, great care will have to be taken to insure that the joint will not show. With a sharp saw the surplus silver with the exception of 1-32 inch is cut off and the end is then carefully filed until it can be just pressed into the groove and fit against the first edge. It is better to have the piece a fraction short than too long, for if too long the last edge will lie over the first instead of fitting closely to it. Starting on the side of the circle opposite the joint and hammering the silver down in the groove, working towards the joint in both cases, if the joint has been neatly made it will not be possible to detect it. The circle is now ready to be turned up to the finished size, it being presumed that it has been roughed out nearly to size. A diamond-pointed tool, a slow speed, and plenty of oil are essential to producing a smooth surface, and on no account should the surface of the silver be touched with emery or emery paper. Y. K.

B——, England.

In the last fiscal year of the United States Navy $376,964 were expended upon the installation and repair of electrical appliances on shipboard and $212,836 on the manufacture and repair of electrical apparatus and appliances in navy-yard shops.

On the recent anniversary, February 17, of the birth of the late Herr Krupp his widow gave $25 each to 2,000 workmen who have been twenty-five years in the employ of the company and $125,000 to the Workmen's Hospital.

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The Unsafety of Men.

We hear continually of the unsafety of steam boilers, elevators, guns which are not loaded and other destructive agencies, but the most unsafe thing of all is the man. We have lately had accounts of two very disgusting boiler explosions. Both were attended with fatal results, but the disgust comes in rather at the culpable ignorance or the regardlessness of inevitable consequences in connection with the ownership and management of the boilers.

In one case there was a return tubular boiler which was bought second hand twenty-two years ago, previous service unrecorded, and after twenty-two years of use in the water works of a Western village it was condemned by a Fidelity & Casualty Company for "lamination, bulged heads, cracked plates, rivet heads rusted off and leaking flues." It was then sold to a man to put into a sawmill. He paid $100 for it and spent $15 to have a patch put on the laminated spot where the inspector had driven his hammer through, making no other repairs. The boiler had been run at the water works usually at a pressure of 60 pounds, with the safety valve set at 70; the new man set the valve at 85, and it is said the engineer gave it several additional turns. This "engineer" was "cheap help" and was his own fireman. He was killed with six others when the boiler exploded after running only a few days.

Then there was the explosion of the six boilers in the power house at St. Louis, killing six men and completely wrecking the plant. Upon investigation there was little more mystery as to the cause of the disaster than in the previous case. The boilers were of a water-tube type and of course "safe." They had been in constant use twelve years, mostly both night and day, and were always crowded to the limit of their capacity. Negro firemen were employed and the firing had always been irregular. The boilers were all fed from one main with no means of controlling the feed to the individual boilers. The water was always low and often invisible in the gage glasss, and the gage cocks were never tried. The safety valves were ordered and understood to be set at 125 pounds, but after the explosion three of them popped at 142, 155 and 170 pounds, respectively, the other three being in such a condition that they could not be tested. It was not thought, however, that excessive pressure was the cause of the disaster; various pieces of the boilers showed fire-red discoloration and two of the water legs were found to be warped and twisted from overheat.

It seems to be quite clear that in both these cases it was not the boilers but the men who had to do with them that constituted the danger factor. In most cases of serious accident it appears, after the event, that somebody has been neglectful or reckless, so that we need most of all more careful inspecting and testing of men without relaxing in vigilant watchfulness over the possibly dangerous appliances with which they have to do.

Tests of High-Speed Steels—Advertising the Results.

In connection with our publication of the accounts of the Manchester tests of high-speed steels we note that some question has arisen as to the propriety of these tests in view of the fact that the results were to be used for advertising purposes, and on this point Dr. Nicolson, who conducted the tests, is quoted as saying:

"It would surely be a mistake to refuse to make a research of scientific or industrial interest simply on the ground that the results were to be used for advertisement. Provided the client paid the cost of the experiments, there could be no objection to an engineering college undertaking such a research."

There are people whose feelings seem to be altogether too delicate in matters of this kind. The fact is that if an inventor or manufacturer has done anything which is worthy of note or which tends to advance the world in the arts and sciences he is entitled not only to whatever of credit or honor there may be in that, but he is entitled also to use this credit in an advertising way.

It should not be forgotten by these super-refined people that one of the great objects of the people who live in this world is to make a living, and those who have such high and mighty ideas of engineering and manufacturing as to suppose that nothing can be done with any improved article or machine that will look like advertising, are taking a position which it seems to us is entirely too hypercritical. Those who are gifted with a proper amount of common sense will, it seems to us, readily perceive that if a man thinks he has gotten up a steel which is better than the commonly used steels or better than anyone else's steel he has a right to ask that this steel be tested and a college has a right to undertake such a test, seeing that the conditions under which it is conducted are fair to all steels submitted to the test. The winner of this test then has a right to use the results in an advertising way—that is, he has the right to call attention to the fact that his steel was tested in competition with such and such other steels and that such and such results were obtained.

The same principle applies to illustrations of improved machines and devices in our columns. There are people who jump at the conclusion that because we give in connection with these the name and address of the builders we are publishing a free advertisement. While that in a certain sense may be true, yet our belief is that so long as this publication is done in the interest of our readers the manufacturer of an improved machine who thus gives us an opportunity to illustrate and explain it is fully entitled to whatever of

advertising benefit there may be in it, though of course we do not in such cases make comparisons but leave that to our readers, who are as competent to judge as ourselves.

There is, after all, nothing particularly discreditable in efforts to make a living or something more than a bare living, and letting people know what you are doing that is noteworthy is one of the ways of doing it.

The Straightening of Rifle Barrels.

The Mechanical Engineer, of Manchester, in an article on the manufacture of rifle barrels vividly depicts the tedious process they formerly went through at the hands of the "setters," *i. e.,* the barrel straighteners, and then describes a new process in use at the works of the Birmingham Small Arms Company as follows:

"It is necessary, however, to inspect all of them, and in the old days this is where the barrel-setter's art would have come in. But the setters of the old school are all gone, and more scientific methods prevail. The barrels are placed in a sort of rack, which holds them tilted end up to the light. But the light is not permitted to stream in unobstructed, as was the case with the old method. It is admitted through a circular aperture, which produces a number of perfectly ring-shaped zones of light and shadow, and not a cone shadow, such as the old setter had to guide him. As the operator of the machine gazes down it, the barrel is given a spin, and now even a novice can tell whether the workmanship under examination has been true. If it is, the rings revolve concentrically; if it is not, then they revolve eccentrically. In the latter case there is no hammering to be done, but by the turn of a screw the machine puts on the pressure required to rectify the irregularity, not in one spot, as a hammer blow would do, but evenly over a fairly large portion of the barrel. By this method, it is claimed, the barrel is not injured, and is consequently unlikely to suffer deflection from truth in the final reamering and turning. In addition to the greater accuracy secured by the new method of testing and setting, the process has resulted in a considerable saving of time and expense. Under the old conditions it was not uncommon for the barrels to undergo seven or eight or even ten settings by the hammer, and the time thus occupied was considerable. Now, however, the process occupies 50 per cent. less time."

We do not think rifle barrels have been submitted to nearly so many "settings" here, nor do we believe it to be necessary when the work of boring has been well done.

As to the necessity for such accurate straightening as has been done, there is probably a good deal of misapprehension. Where the sights are located on a rifle without possibility of lateral adjustment and this is done by "fixtures" and without testing for accuracy, as is the usual custom in manufacturing military arms, it is perhaps important on that account that the bore of a rifle should be straight; but that a rifle barrel having a curve to a radius of, say, 100 feet would shoot any less accurately on that account, we do not believe. We have all heard of the darky's gun that had been bent crooked and which he declared was better so because "it would shoot around a corner" and have laughed at the idea of a gun doing such a thing, but few have perhaps gone further and clearly recognized the fact that it is the last inch or so of the bore of a rifle that determines the direction the bullet will take and the barrel may be ever so crooked behind that point so long as it is not so crooked as to interfere with the proper action of the rifle grooves or with the passage of the bullet and the gun will be just as good as though the barrel were precisely straight throughout. It is the direction of the nozzle that determines where a fireman's stream of water shall strike, not the twists and turns of the hose.

Proposes to Build a National Railroad.

At a recent meeting of the Manufacturers' Association of New York, in Brooklyn, ex-Congressman William J. Coombs, who has acted as representative of the government in the collection of claims against the various Pacific railroads, is reported in *The Times* as having proposed that a national railroad be constructed under the supervision of the authorities, upon which any railroad company might operate trains. Such a road properly equipped, he declared, would supply a very great want, and would prevent the absorption of local lines into the great systems, for as soon as they reached the main line they would have use of the public way to the great markets. His address was, in part, as follows:

"According to the recognized principle of political economy, the price that our surplus products bring when sold abroad, less freight, fixes the price of the whole product at home. For instance, the price of wheat in the foreign markets is set by competition of all wheat-producing countries. The price of our wheat in the West would be the foreign price less the freight. If this great combination can set the price of freight, they effectively fix the price of wheat in the hands of our farmers, from which there would be no appeal. What is true of wheat is equally true of any other great product. This is a power that cannot be permitted to rest in the hands of any combination of men.

"Why, if it is legitimate for the government to construct a waterway through land in aid of commerce through which any citizen or company can upon paying toll and complying with strict regulations, convey his or its boats or barges, is it not just as legitimate and feasible for it to construct a steel way over land, upon which any railroad company, new or old, any corporation or private individual can convey a car or train of cars to the desired market?"

If it were decided that such a publicly owned road were needed, then it seems that it would be folly to build a new one to compete with those already in existence. For, if that were done and rates charged that were materially lower than those prevailing on the present privately owned roads, the privately owned roads would have to meet these rates or go out of business. This would mean that their "earning power" would be correspondingly reduced and the value of the stocks would fall in like measure. If we say that that would simply be squeezing the water out of them and that they could still earn fair pay for the actual service performed, that might be true enough; but if so, then precisely the same thing would be accomplished and with much the same result to the stockholders if the present roads were condemned and paid for at a price based upon their earnings at rates that would be a fair return for services rendered. Here, as in many other things, Switzerland has much to teach us. She has been all through this matter of privately owned and publicly owned railroads and has recently, as a result of public discussion and voting thereon, purchased the last of the privately owned railroads.

As an illustration of the difficulty of presenting fair arguments against the joint use of the proposed union engineering building by various engineering societies, we note the publication in one of our contemporaries, which seems to be specially opposing this movement, of some arguments which ought to be considered absurd and would scarcely be thought of except by a man in a rather desperate frame of mind. For instance, we note that one individual states that he asked a man whom he describes as "an operator in real estate" the probable cost of running and maintaining the proposed building. This man stated that the items would foot up to $30,000 per annum, according to which the Civil Engineering Society would have to pay $12,000 per annum, whereas the cost of maintaining their present building is only $4,000 per annum. It is to be noted here that the name of the "operator" making up the items of cost is not given, nor are the items themselves given, so that this amounts to nothing more than that an unknown man thinks the cost will be $30,000. In other words, the letter as it stands is of absolutely no value. One has no means of knowing what items have been included that should be excluded, and the probability is that a great many unwarranted items have been included to make up a total which is far in excess of what may be expected as to the expense of maintaining the building.

Bronze for Heavy Guns.

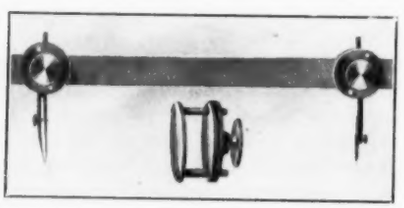
Austria is now the only nation using bronze as the material for its heavy guns, and a circular recently put out by the Austrian War Ministry indicates that it is the intention of that government to retain it. It is claimed in the pamphlet referred to that this bronze, forged according to a secret process, is equal to nickel steel, and that the cost of the inner tube is three-fifths less than that of the steel tube. Another advantage is that an injured bronze gun can have a new jacket fitted to it, which is impossible with a steel one. The Austro-Hungarian artillery has always used bronze for their gun material. In that service there have for decades been officers who have directed their attention to the improvement of this metal. The invention of nickel steel and the general advance in steel manufacture are certainly important, but the same period has been utilized in Austria for the perfecting of bronze. Uchatius, who in the seventies discovered a special process for forging bronze, also found that good homogeneous bronze could be hammered in a hot or cold state, and therefore can be improved in quality. The present director of the Vienna Arsenal also obtained very favorable results in forging this metal, producing a kind of bronze not surpassed, it is claimed, by the best cannon steel, through a combination of metals, careful alloying and judicious rolling.

At the One hundred and eighty-fourth meeting of the American Institute of Electrical Engineers, to be held at the Chemists' Club, 108 West Fifty-fifth street, New York, Friday, February 26, at 8.15 P. M., the following papers will be presented and discussed: "European Practice in the Construction and Operation of High-Tension Transmission Lines and Insulators," by Guido Semenza, chief electrical engineer of the Italian Edison Company, of Milan, Italy; "Conductivity of the Atmosphere at High Voltages," by Harris J. Ryan, professor of electrical engineering, Sibley College, Cornell University, Ithaca, New York.

Some New Things.

BEAM COMPASS ATTACHMENTS.

The attachments shown in the accompanying half-tone have been devised to



BEAM COMPASS ATTACHMENTS.

fill a long-felt want for something that will take the place of the ordinary beam compass by making use of the case instruments and a wooden beam and still be simple and efficient while cheap. They hold anything that can be placed between the clamping washer and beam, including tubular as well as angular pieces, with perfect rigidity. They are manufactured by Mr. A. W. Stephens, Ithaca, N. Y.

A HOSE-CLAMPING DEVICE.

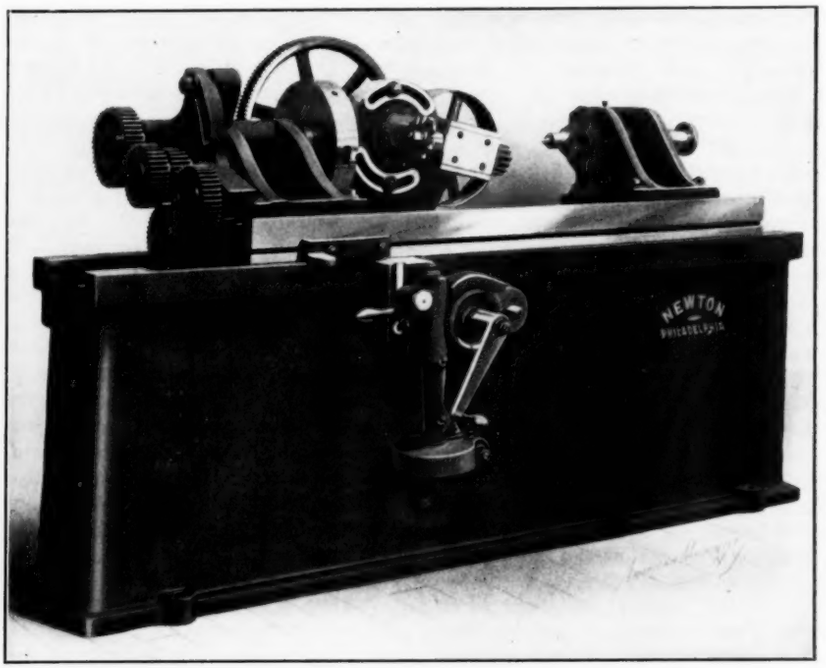
The half-tone shows a device for securing hose or rubber tubes to metallic nozzles, as in connecting to cocks or hydrants

NEW HOSE-CLAMPING DEVICE.

or in joining lengths of hose together. The wire is coiled large enough to just slip over the rubber, the ends then standing apart at a considerable angle. When the ends are brought together and hooked as shown, after the manner of a safety pin, the hose is securely clamped. Made by A. B. Christman, Dayton, Ohio.

THREAD MILLING MACHINE.

The accompanying illustration shows a



THREAD MILLING MACHINE.

thread milling machine which is the product of the Newton Machine Tool Works, of Philadelphia, where it has been in operation for some time. The cutter arbor of the machine is made to swivel in either direction for the setting to the angle required by the pitch of the thread, and is strongly back-geared. The spindle which gives the rotative movement to the screw or worm obtains its motion through gearing directly from the cutting head and the table traverse is obtained by gearing connecting with the change gears which give rotative motion to the worm driving spindle. The table has an automatic stop to the feed arrangement, and will mill 3 feet between centers, the swing being 16 inches. The top of the table is planed on an angle so that compound used in milling will drain to one side. The cutting head has an in-and-out adjustment with micrometer attachment, and threads of any pitch, either single, double or quadruple can be cut.

MAGNETIC CHUCKS.

As our readers will remember, various types of magnetic chucks made by O. S. Walker & Co., of Worcester, Mass., have at different times been illustrated in these columns; and we now present some further illustrations showing several new forms of these interesting appliances.

The chuck in Figs. 1 and 2 is designed especially for use on toolroom grinders and is really a development of the magnetic grinder chuck originally made with a plain base only, then fitted with a base

which allowed the top to be elevated at one end so that taper work might be ground, and now constructed in one form (the one shown) so that the body may be raised at one end and tilted, if desired, toward front or back, thus making it possible to grind bevel edges on both straight and taper pieces. This tilting movement is secured through the medium of an auxiliary base on which the chuck proper is mounted. The body of the chuck itself is practically identical in design with the plain and the tilting chucks just referred to, all three styles as now made having fine-toothed magnetic faces suitable for holding very small pieces.

The construction of this improved chuck is clearly shown in the line engraving. The body *A* or chuck proper hinges on the pivot *B*, and, after being elevated by the screw *C*, is clamped by a bolt passing through the hole *D*. This adjustment is provided for wedge-shaped pieces, the correct setting for any desired taper per foot being obtained by means of graduations at the side of the chuck. The base plate *E* is provided, as shown, with parallel V-grooves at the edges and rests on pins or short rods *F* which are fastened to the lower or auxiliary base *G* by means of screws. The ends of *E* and *G* are milled off to coincide in length and graduated plates *H* and *I* are bolted rigidly to the ends of *G*. These plates are provided with curved slots at either end struck from the centers of pins *F*, and through these slots are inserted hexagon head cap-screws tapped into the ends of *E* for the purpose of clamping the chuck in any desired position, it having first been tilted either to the right or left on the pins fastened to the base. The ends of the plates are graduated in degrees, the right-hand plate indicating the degree of the incline when the chuck is tilted toward the operator and the left-hand plate indicating the angle when the chuck is tilted from the operator. One important feature of this chuck is that it can be taken apart by the removal of two or three screws and can then be used as a taper base chuck or as an ordinary flat chuck at pleasure. However, if it is not desired to take it apart for parallel work, it can be readily set so that the top face is parallel with the base by simply lowering it on to supports *F*.

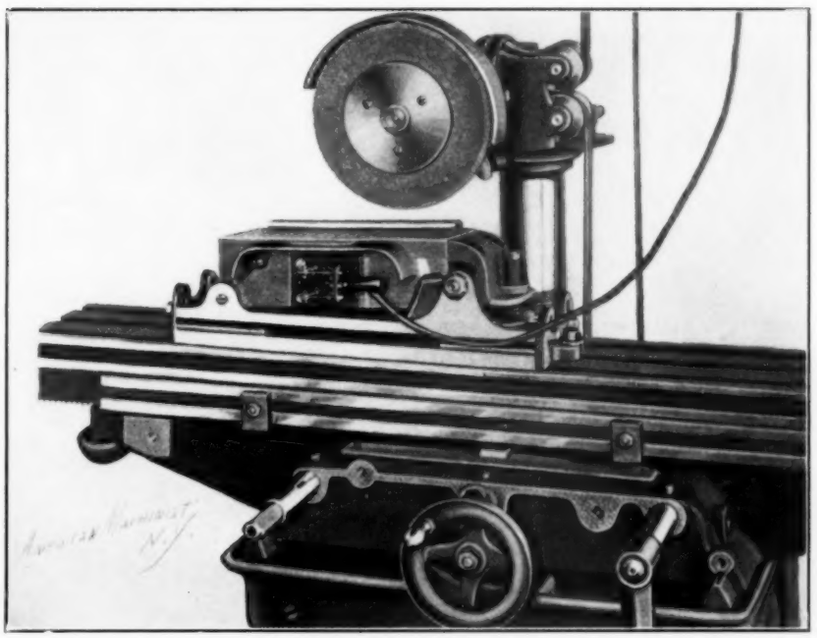


FIG. 1. CHUCK FOR SURFACE GRINDER.

Fig. 3 shows one of the larger rotary chucks (above 12 inches diameter) for lathe or grinder work, all such chucks containing four or more separate magnets. In Fig. 4 is illustrated a special rotary chuck built in two sizes (10 and 12 inches) to suit the requirements of ball and roller bearing manufacturers, and designed to be used only on the grinder although photographed on a lathe. The work shown consists of sixteen washers, 1½ inches in diameter, which are

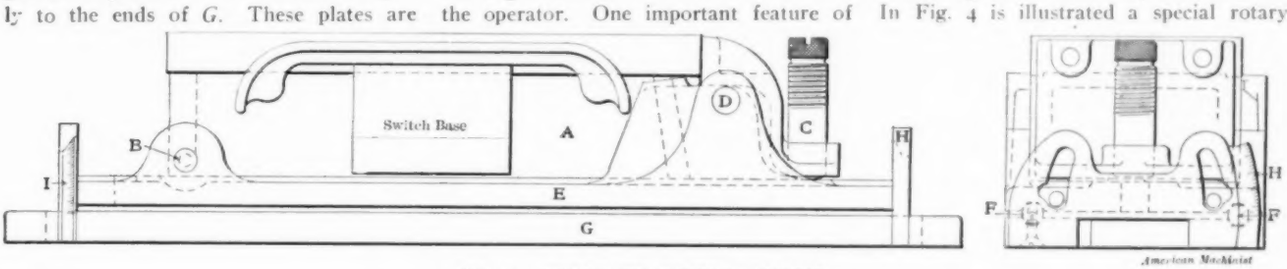


FIG. 2. CHUCK FOR SURFACE GRINDER.

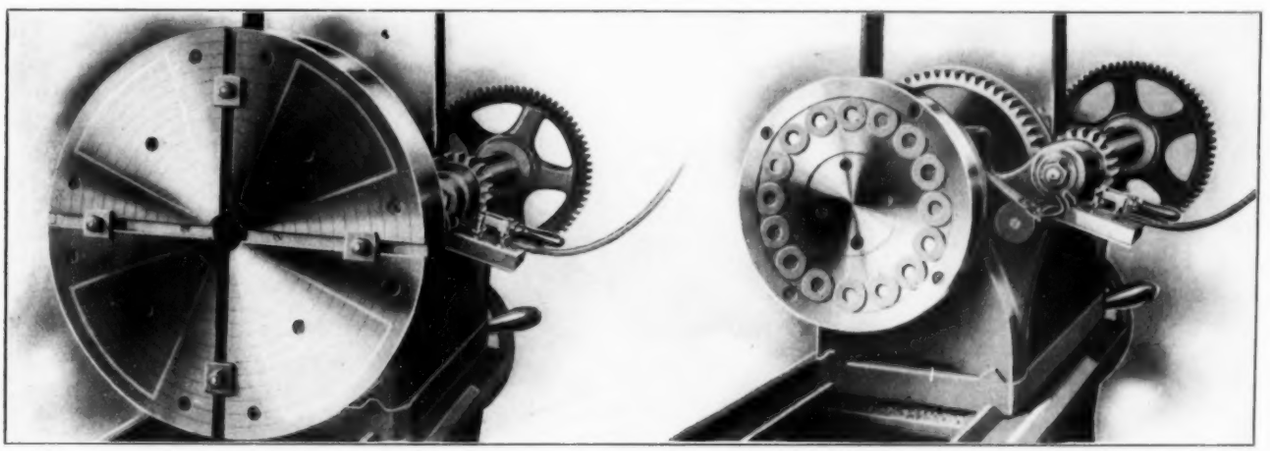
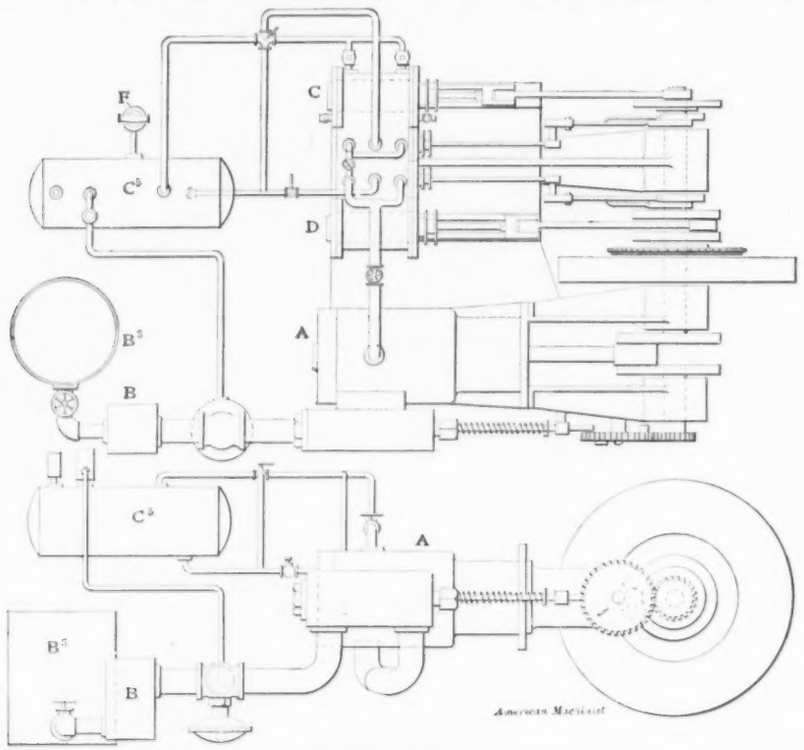


FIG. 3. ROTARY CHUCK.

FIG. 4. WASHER GRINDING CHUCK.

ground off parallel at one setting. It will be seen that the chuck is recessed and a small shoulder formed against which the washers rest, this preventing any possibility of their flying off during the grinding operation. By a close inspection of the half-tone the course of the magnetic gap which separates the chuck poles can be seen. This gap shows as a faint white line and is confined to a narrow portion of the chuck face to concentrate power under the work to be ground.



A COMBINATION MOTOR.

A COMBINATION MOTOR—OIL OR GAS ENGINE WITH AN AIR COMPRESSOR AND AIR MOTOR.

The drawing shows the essential features of a combination motor recently patented by Charles T. Osborne, 413 West One Hundred and Fiftieth street, New York city. It comprises a four-cycle gas or oil-vapor engine of any familiar type with an air compressor operated by the same crankshaft. A compressed air reservoir of sufficient capacity is provided, and this is normally kept charged to a determined maximum pressure, and when this pressure is reached the compressor ceases to act as such. The air compressor is always, at the will of the operator, instantly convertible into an air motor, or, as shown in the drawing, a separate air motor is provided, and this is always ready for starting the crankshaft and keeping it in motion until the operating cycle of the gas engine is fully established. The air motor is also always ready, provided there is sufficient pressure in the air reservoir to co-operate with the gas engine as an auxiliary motor when the load is temporarily increased, as in the case of an automobile climbing a hill or rapidly accelerating its speed. This arrangement allows the gas engine to perform its own functions more economically, as the working power may be differentiated at will by driving the air compressor, by ceasing to compress air or by using the air motor to help to drive. Arrangements are provided for taking advantage of the differences of temperature which occur, the exhaust from the air motor acting to cool the gas engine cylinder and the gas engine exhaust heating and increasing the volume of the compressed air before it enters the motor.

Referring to the cut: *A* is the gas engine cylinder; *B*, carbureter; *C*, double-acting air compressor cylinder; *E*, hand or other pump for the initial charging of the air reservoir C^3; *D*, air motor cylinder; B^2, gasoline tank.

The motor, it will be seen, is adaptable to automobiles, to the propulsion of boats or to any of the uses of a stationary engine.

HOGGING AND FINISHING REAMER.

The reamer shown in the accompanying cut is adapted for heavy roughing operations and also for finishing. The blades are made of high-speed steel, are adjustable to maintain the proper size, and, being provided with a number of recesses to receive the screw heads, may be adjusted longitudinally step by step to compensate for the stock ground off from their ends in sharpening. The blades are set at an angle to give a shearing cut, and ample chip room is provided, so that the tool is well adapted to working in holes requiring boring to size accurately in a single operation. Ott. Mergenthaler Company, Baltimore, Md., are the makers.

HOGGING AND FINISHING REAMER.

Technical Publications.

"The Localization of Faults in Electric Light and Power Mains." Second revised edition. By F. C. Raphael. 205 5½x8½-inch pages, with 112 illustrations. The D. Van Nostrand Company, New York; The Electrician Printing & Publishing Company, London. Price, $3.00.

The discussion of the localization of faults in electric light and power mains was, we believe, first taken up in a systematic manner in the first edition of this book which thus filled a gap in technical literature. In the second edition the revision is quite complete, some of the methods given in the first edition having been omitted as too elaborate for ordinary use, while others of a more simple character have been added. The author is fully informed regarding European methods and American engineers will find much of interest and profit in his book.

"The Lay-Out of Corliss Valve Gears." By Sanford H. Moss. 108 3¼x6-inch pages with three folded plates and eight text cuts. Van Nostrand's Science Series, No. 119. D. Van Nostrand Company, New York Price 50 cents.

It is, we believe, a remarkable fact that until the publication of the articles by Mr. Moss in our columns last year there was not in print a study of the Corliss valve gear from the designer's standpoint that could be considered to approach satisfaction. The present volume is a reprint of those articles with, however, many revisions and additions. While primarily a study of the kinematic principles involved, the book is much more than a mere study of movements. The prevailing values of leading dimensions are given in a manner to satisfy a beginner that his work will not depart essentially from customary practice, while the discussion being strictly rational should lead to better results than are often obtained. Many who regard themselves as experts in the design of the gear will, we doubt not, find profit in Mr. Moss' treatment of it.

"A Manual of Marine Engineering." Fifteenth edition, revised, enlarged and in part rewritten. By A. E. Seaton. 707 6x9-inch pages, with 240 illustrations. Charles Griffin & Co., London.; D. Van Nostrand Company, New York. Price, $6.00.

To those who are acquainted with previous editions of this great work a mere announcement of a new edition is sufficient. The revision is more extensive than the title page would indicate. New chapters have been added and others revised in the light of recent knowledge and experiments, the enlargement and revision being so extensive that the type has been reset throughout and to a somewhat larger page than heretofore. The book is an example of technical literature at its best. Very few fields of mechanical engineering have anything of equal merit. Written for the marine engineer, portions of it are of course of little use to others, but at the same time its presentation of the marine engine from the standpoint of design is such as to render it of great value to the designer of stationary engines. Engineering needs more books of this class, and the sustained recognition which this one has received would seem to make their preparation a safe business venture.

"Kalender fuer Seemachinisten, 1904." By E. Ludwig and E. Linder, engineers for marine engine construction, with an appendix on nautical matters by Prof. P. Vogel. Issued by Dr. G. Bauer, chief engineer of the Stettiner Maschinenbau A. G., "Vulkan." 264 4x6½-inch pages with 273 figures, two maps and a plate of flags, also diary and memorandum pages. Munich and Berlin: Press and publishing house of R. Oldenbourg. Price, 6 marks.

Dr. Bauer, whose name is attached to this pocket handbook for marine engineers, is the author of a larger work on calculation and construction of marine engines and boilers, recently noticed in these columns. The present volume aims to furnish a reference summary of the theoretical, as well as practical, knowledge which is becoming increasingly necessary for men who have to do with machinery on shipboard. Starting out with mathematical tables and formulas, mechanics, physical data, etc., it passes on to design of engines, boilers and pumps, electrical and other marine appliances, briefly treats of naval architecture, comprises a chapter on navigation and closes with miscellaneous tables and admiralty statutes. It will probably occupy an honorable place among engineering handbooks.

"Proceedings of the Society for the Promotion of Engineering Education," Vol. XI. 379 6x9-inch pages. Engineering News Publishing Company, New York. Price to libraries, $2; to others, $2.50.

This annual volume contains more of interest than has usually been the case. One of the papers—presented after the author's death—is from the pen of Professor Thurston, and is probably the last piece of literary work undertaken by him. Of special importance is the report of a committee on technical books for public libraries, wherein about 345 titles have been compiled. There is said to be an appreciable movement toward the inclusion of more technical books in public libraries than heretofore, and the list contained in this report will be of immediate assistance to librarians. A large amount of attention is given to the inclusion, in engineering educational courses, of work bearing upon the business side of manufacturing. Three papers relate to this subject, and others refer to it. A paper on "Engineering English," by Professor J. T. Johnston, is a well-deserved criticism of the looseness with which many engineers use their mother tongue, and includes many laughable examples of bad English which the author has observed in the writings of engineers.

"Machine Design." Part I. By C. L. Griffin. 78 7x10-inch pages, with 16 illustrations. Instruction paper of the American School of Correspondence.

At page 1341, Vol. 25, we took occasion to notice in complimentary terms the strikingly original paper on mechanical drawing which Mr. Griffin had prepared for the American School of Correspondence. The present paper is quite as striking as a departure from conventional methods. It may be described as true to its title, in that it discusses machine design as distinguished from the design of detached parts. After some discussion of methods it takes up at once the design of a machine to be set on the floor of a building to drive a wire rope from the overhead sheaves of an elevator or hoist, the load, speed and length of rope to be reeled in being given. Starting with these data the first illustration is a fac-simile reproduction of the designer's first rough sketch wherein the general arrangement is determined. Following this comes the determination of the size of the rope and of the proportions of the drum to carry it, and after this in turn come the gears, the pulleys, the shafts, the belt, the bearings and the brake, followed by the preliminary layout of the whole machine to scale, but with the leading dimensions only given and following this again come the detailed drawings of the parts. As the determination of the dimensions of each part is taken up, reference is made to Part II, which is not before us, but which is intended to be a simplified and condensed reference book. The whole discussion savors of actual drawing-office methods, the necessity for system in the matter of calculations being especially emphasized by fac-simile reproductions of the calculations made in connection with the determination of the various parts.

The American Institute of Electrical Engineers.

We have before us the February program of meetings of the American Institute of Electrical Engineers, and it is a striking illustration of the working of the recent policy of the Institute in broadening its work through the formation of local branches. The calendar for February shows no less than twenty-four local meetings, which will be distributed throughout the territory bounded by Boston and St. Louis and by Toronto and Cincinnati.

The United States Civil Service Commission announces an examination on April 1, 1904, to secure eligibles from which to make certification to the position of constructing engineer in the Geological Survey, at salaries of from $3,600 to $4,800 per annum. It is desired to secure in the positions to be filled engineers who have achieved wide professional reputation in connection with hydrographic or hydraulic work. Persons whose experience is not of the character indicated cannot become eligible as a result of this examination. This examination is open to all citizens of the United States who comply with the requirements. Competitors will be rated without regard to any consideration other than the qualifications shown in their examination papers, and eligibles will be certified strictly in accordance with the civil service law and rules. Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 304 and special form, which should be properly executed and, with the material required, filed with the Commission at Washington prior to the hour of closing business on April 1, 1904.

The recent disastrous fire in Baltimore destroyed the offices of the district manager of the Bullock Electric Manufacturing Company. Temporary quarters have been located at 303 Cortlandt street, where all inquiries should be addressed.

A moderate estimate shows that at least 50 per cent. of the gas sold to-day is used for other purposes than lighting. The light-giving power of the gas burnt as a luminous flame has become of little or no importance by the introduction of the incandescent mantle, which enables 5 feet of gas, converted to a non-luminous flame by the Bunsen burner, to produce a light equal to about 100 candles against the 12 or 14 candles of thirty or forty years ago.—*The Engineer.*

Electricity is now getting to be sold both at wholesale and at retail. The big water-power plants are the wholesalers, and they are finding it often does not pay them to have anything to do with the distribution or retailing of the current, so they leave that to the local and generally already existing companies.

Joshua Buckton & Co., of Leeds, England, have recently completed a testing machine which is declared by *The Engineer*, of London, to be the largest ever built anywhere. It was built for the Conservatoire National des Arts et Métiers, of Paris, and will test columns up to 27 meters (88 feet) and 1 meter square. On such a column the machine will impose a crushing load of 300 tons. It will also test in tension and shearing, and has elaborate recording devices and other appurtenances.

In a Western sawmill recently a bandsaw broke while running at a high speed and the sawyer took a cant hook to stop the top wheel. He stopped the entire mill for a week or so, or until the wheel could be replaced.

Personal.

E. C. DeWolfe, who a short time ago became connected with the editorial force of the *Iron Age*, has resigned and become a member of the Russell-DeWolfe Company, 355 Dearborn street, Chicago, compilers, editors and publishers of trade catalogs.

F. C. Lau has established a company at 27-29 South Clinton street, Chicago, Ill., known as The Steel Treatment Company, its specialty being to establish hardening plants and teach the art of hardening, annealing and other treatment of steel. The company will also make microscopical examinations and analyses of steel.

Obituary.

Herman Beardsley Butler, vice-president and treasurer of Joseph T. Ryerson & Son, Chicago, died February 10.

New Catalogs.

Meadville (Pa.) Vise Company. Illustrated catalog and price list of Barrett's vises, for machinists, wood-workers, etc., including heavy chipping vises, combination vises, pipe vises, etc., etc. 5x6½, pp. 25, paper.

Armstrong Bros. Tool Company, Chicago, Ill. Illustrated catalog and price list of Armstrong tool-holders for turning, planing, boring, slotting, threading, cutting off and drilling metals. 3½x6, pp. 68, paper.

Joseph Dixon Crucible Company, Jersey City, N. J. We have received from this company a descriptive catalog and price list of Dixon's graphite lubricants. The booklet is neatly arranged, well printed and well illustrated. 5x7½, pp. 20, paper.

J. T. Slocomb Company, Providence, R. I. Catalog and price list of machinists' tools, including micrometers, micrometer calipers, separately and in sets; micrometer heads, standard end measures, graduated dials, micrometer gages, etc. 6x9, pp. 24, paper. Illustrated.

We have received from C. A. Nordquist, 39-45 W. Randolph street, Chicago, Ill., a little catalog illustrating and describing the "Chicago" adjustable boring tool. This is a universal tool to be attached to tool-post lathes for all kinds of boring. Illustrated by photographs. 3½x6¼, pp. 11, paper.

The Auto-Igniter Company, New York. A catalog recently received shows a new ignition dynamo for gas and gasoline engines, gotten out by this company. It is an inductor generator type of machine and its special feature is that it has no wearing parts, no batteries nor spark coils. Illustrated. 3½x6, pp. 15, paper.

The Jeffrey Manufacturing Company, Columbus, O. Catalog No. 52 of coal-washing machinery. Photographs are reproduced showing the installation of Jeffrey coal-washing plants at many representative mines. The catalog is well printed on coated paper and the half-tone illustrations are of a high order. 7x9, pp. 76, paper.

Fosdick Machine Tool Company, Cincinnati Ohio. Illustrated folder showing the new No. 1 horizontal boring, drilling and milling machine made by this company. The machine is described in detail. Besides a number of working drawings showing the construction of the machine, photographs are reproduced showing it engaged on actual boring, drilling and milling work.

Woodward Governor Company, Rockford, Ill. This catalog, which is well illustrated throughout with drawings and photographs, shows Woodward governors adapted and applied to different types of water wheels. Besides describing in detail the different governors, it contains a chapter of general information for selecting and installing governors. 6x9, pp. 47, paper.

New Corporations.

The American Crude Rubber Company has been formed at Colorado Springs, Colo. Two plants are proposed to be erected, one in Denver and the other in Colorado Springs. Crude rubber will be manufactured. Frank G. Peck, general agent of the Portland Gold Mining Company, which has an office at Colorado Springs, was one of the incorporators. Eastern and Denver capital makes up the capital stock, which is $1,000,000.

International Automatic Device Company, New York city; capital, $25,000. Directors: Hugo Folke, Isador Reif and Valentine Berninger, New York.

Witherbee Igniter Company, Jersey City, N. J.; capital, $50,000. Incorporators: Thomas S. Witherbee, Albert E. Milliken, Mervyn A. Rice, Thomas Mullally.

Knickerbocker Hand Sewing Machine Company, New York city; capital, $30,000. Directors: J. D. Fearlake, F. B. Pierce and F. A. Huck, New York.

Electric Block Railway Signal Corporation; president, F. C. Robinson, Farmington, Me.; treasurer, W. H. Cook, Farmington, Me.; director, E. H. Whitney, Farmington, Me.

U. S. Cash Sales Company; objects, making and sale of vending machines; president, L. J. Coleman, Gardiner, Me.; treasurer, L. A. Burleight, Augusta, Me. Directors: As above and F. S. Cowles and F. W. Tucker, of Norwalk, Conn.

National Fiber-Tube Works; capital, $30,000; president, Edwin L. Mun, Holyoke, Mass.; treasurer, J. Lewis Perkin, Holyoke, Mass.

American Heating & Ventilating Company, Auburn, N. Y.; objects, manufacture ventilating apparatus, etc.; capital, $25,000. Incorporators: Henry Bender, Thomas D. Poole, Philadelphia, Pa.; H. D. Le Cato, Auburn, N. Y.

Pacific Tube Works; president, J. C. Ward, Portland, Me.; treasurer, W. H. Thorpe, Boston, Mass.; clerk, B. G. Ward, Portland.

Manufacturers.

The Penn Shovel Company, of Corry, Pa., may build in Warren, O.

A serious fire has occurred in a building of the Brooklyn (N. Y.) Chair Company.

East Lake, Ala., is considering the question of building an electric lighting plant.

It is expected that work will soon begin on enlarging the Santa Fe shops at La Junta, Colo.

The West Virginia Plate Glass Company, Morgantown, W. Va., is soon to build a large plant.

H. B. Wells & Son, of Ithaca, Mich., machinists, founders and manufacturers of hot air furnaces, think of locating at Boyne, Mich.

The Behrens Combination Wagon Company, Lancaster, O., expects to enlarge its plant.

Work has commenced at Clinton, Ill., preparatory to enlarging the shops of the Illinois Central.

Collmer Bros. are to build a factory at South Bend, Ind., for making tools and bicycle specialties.

Work is about beginning on an addition to a factory of the Rockford (Ill.) Chair & Furniture Company.

Ferguson, Okla., has prospects of becoming quite an industrial center. Salt and stucco plants are locating there.

The Dairy Queen Manufacturing Company, of Flora, Ind., maker of cream separators, will move to Delphi, Ind.

Some damage by fire is reported to have occurred to the factory of the Taunton (Mass.) Eyelet Company.

The construction of a new gas plant by the Consumers' Gas Trust Company, Indianapolis, Ind., is under discussion.

The Northwestern Mantel Company, Minneapolis, Minn., is about to build a marble mill at a cost of about $50,000.

New Castle, Pa., councils have ordered plans and specifications for the erection of a $65,000 municipal electric plant.

It is stated at Vincennes, Ind., that work will soon begin on a new power-house for the Citizen's Street Railway Company.

The Lake City Stone (or Litholite) Company, Dunkirk, N. Y., will build a second large structure in the immediate future.

A new company has recently organized to operate the plant in Florence, Mass., formerly of the Florence Machine Company.

The Greensboro (N. C.) Electric Company will install a steam turbine, add another boiler and make other additions to the plant.

It is reported that the Pennsylvania Railroad expects to erect some buildings at Harrisburg, Pa., for shop purposes, etc., in the spring.

Work on a machine shop plant at Kittery, Me., Navy Yard for the steam engineering department is expected to be started the coming spring.

The Brodesser Elevator Manufacturing Company, Milwaukee, Wis., has secured plans for a factory building, part three stories and part one story.

The City Council, Baton Rouge, La., has adopted an ordinance granting a franchise to Messrs. Kretz & Wieck to erect an electric light and power plant.

The Dealers' Steam Packing Company, which is said to have works and business offices in Philadelphia, is about to move its plant to Palmyra, N. Y.

A large pulp and paper mill is to be erected by the St. John Lumber Company, near its new sawmill, three miles above Van Buren, on the St. John River, in Maine.

A mill building at West Baldwin, Me., used by Fred. D. Harding, manufacturer of washboards, hose supporters, etc., has been burned and will be rebuilt on an improved plan.

The Beaver Falls (Pa.) Manufacturing & Fuel Company, manufacturer of drills, proposes to erect a new building, 210x69 feet, two stories, to be fitted with machinery, etc.

A good sized plant is being, or soon will be, built at Rosedale, Ind., for the manufacture of concrete blocks. The movement has been set on foot by John F. Sinclair, of that place.

A two-story factory, 60x85 feet, is about to be built for P. Elmer Weitzel, Philadelphia. His firm is in the lumber business, which may indicate the nature of the plant.

Sidney Southworth, an Eaton, Mich., farmer, will remove to Lansing and establish a factory to manufacture the Southworth self-feeder, a patent attachment for bean and wheat threshers.

The Broderick-Quinlan Manufacturing Company, boiler builders, Montpelier, Ind., has purchased a hydraulic riveter, plate punch and other machines for the annual enlargement of its plant.

The Emmert Manufacturing Company, Waynesboro, Pa., maker of universal vises, will build a small addition to the foundry to accommodate a new core oven and the core-makers' department.

It is rumored that a plant of Root Bros. Company, hardware specialties, Plymouth, O., will be rebuilt on a larger scale than before. We understand that the plant referred to is a foundry, at least in part.

The Root & Van Dervoort Engineering Company, manufacturer of gas engines, East Moline, Ill., is planning for a new foundry, 40x70 feet. The company is also preparing to manufacture automobiles.

The Sabina (O.) Pump Company has been formed by Joe C. Allen, J. C. and W. A. Burnett, for the purpose of manufacturing a non-corrodable barrel and basement pump recently patented by Mr. Allen.

It is proposed to enlarge the plant of the Scott Patent Brick Car Company, Knoxville, Tenn. Besides manufacturing the Scott car, all kinds will be repaired and steam shovels and other railroad appliances made.

The Commonwealth Electric Company, Chicago, Ill., has secured 195,000 square feet of ground additional, with a view to important extensions. The lease of the present occupant of the land will expire April 30, 1905.

The Enterprise Manufacturing Company, of Pennsylvania, hardware, will erect an addition to its plant on the east side of Third street, south of Dauphin, Philadelphia, to be used as a blacksmith and drop-hammer shop.

The Duluth (Minn.) Tar Company has been formed with a capital stock of $100,000 to manufacture tar by-products, tar paper, etc. It is affiliated with the Zenith Furnace Company, of that place. A plant will be built.

The Delta Cement Company is reported organized to build a plant at Scipio, Mich. Wesley Sears, of Jackson, is president; Prof. D. E. Haskins, of Scipio, is vice-president and Dr. E. R. Espie, of Jonesville, secretary and treasurer.

Residents of Charlotteville, eight miles north of Lockport, Niagara County, N. Y., have formed a stock company, with William Collins at the head, and will carry on a general foundry business in a building which is being erected.

It is stated at Vancouver, B. C., that preliminary surveys for a power dam and flume at Stave River Falls, to generate electricity for the Stave Lake Power Company, have been completed. C. E. Stoess, consulting engineer of the Stave Lake Power Company, has returned to the city.

The Elliott-Fisher Company, manufacturer of billing machines and book typewriters (general offices, 396 Broadway, New York city), desires to consolidate the two plants it is now operating and is looking for a suitable factory with not less than 50,000 square feet of floor space, in one or more buildings, not too far from New York—preferably within 30 miles.

A petition has been filed for the voluntary dissolution of the Oswego (N. Y.) Machine Works Company, manufacturer of paper cutters, the reason stated by Niel Gray, Jr., the principal stockholder, being that he desires to conduct the works as sole proprietor. It is said that the plant, which has been enlarged twice since its establishment in 1893, will be enlarged again.

It is stated at Shelby, N. C., that the Lily Cotton Mill & Electric Power Company, of which John F. Schenck is president, has decided to locate the mills just south of Shelby. This plant will be run by electric power. The development of the electric power will be at Stice shoals, five miles south of Shelby. The Shelby Cotton Mills, Belmont Cotton Mills and the Shelby Electric Light Company will use electric power furnished by this company.

The American Suction Gas Producer Company has been organized in Lansing, Mich., and incorporated with $25,000 paid in on the capital stock of $100,000, with James H. Seager, Houghton; S. L. Smith, Detroit; J. B. Seager, Lansing; S. F. Seager, Fred L. Smith and Angus Smith, Detroit, as the Board of Directors. The company has purchased the American rights to manufacture a machine for the production of gas direct from coal or other fuel under a process which was patented in Germany and has been in use there for some time. It is claimed that gas for gas engines can be produced much cheaper and easier than from gasoline. It is understood that the gas can also be used for fuel and illuminating purposes. The company will commence the manufacture of the machines at Olds Gasoline Engine Works, but it is expected that ultimately a large plant will be needed to care for the business.

From an Aiken, S. C., source we derive a piece of local news which will be of considerable industrial importance if half of it proves true. There is some fine clay in the region, part of which was purchased by Dr. J. J. McMillan, of Warrenville, and F. B. Henderson, of Aiken, who have been making arrangements for its exploitation; for which purpose the Pioneer Chinaware Company is being formed. Some time ago a sample was sent to Harrisburg, Pa., as a result of which Capt. John McLeod Murphy, Mr. Mosser and A. C. Zacharias, of that place, together with Andrew Carnegie, Gen. Nelson A. Miles and Col. A. A. Pope, the bicycle and automobile manufacturer, of Hartford, Conn., are planning for a big aluminum plant to utilize this clay. It is said to contain 70 per cent. of aluminum. The process to be employed is a chemical one which, it is claimed, will yield aluminum at less than 12½ cents a pound. The Harrisburg men have already visited Aiken and were shortly to return with Gen. Miles and Col. Pope. It is proposed to manufacture aluminum goods as well as the crude metal.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Stamping dies and tools designed for rapid work. Box 73, Racine Jct., Wis.

J. Gregory, 140 W. 23d st., New York, specialist in small machine designing.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented Specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Owner of machine tool newly patented will place it on royalty. Address P. O. Box 112, Anderson, Ind.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Special machinery for reducing labor and increasing profits, designed and perfected. C. E. Sargent, M. E., 1214 Manhattan, Chicago.

Exceptional machine shop facilities; best mechanical ability; our rate 60c. per hour. Pollard-Alling Mfg. Co., 312 E. 23d st., N. Y.

A complete course in mechanical drawing is given in Rogers' "Drawing and Design," $3. Illustrated catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

Machinists will find in Rogers' Machinists' Library (3 vols., $7, payable $1 monthly) the most helpful set of home study and reference works. Illustrated machinists' catalog, post free. Theo. Audel & Co., 63 Fifth avenue, New York.

Want to furnish men of proved ability, as managers, superintendents or foremen, in the metal-working industries; no charge; also want men to fill such positions. For terms address James Brady, Room J, 20th Floor, 220 Broadway, N. Y. City.

Well-known designer and shop manager wishes associates with capital to build a fully developed and highly successful machine tool; good profits, based on actual knowledge of costs—no guesswork—can be shown. Address Box 153, AMER. MACH.

Wanted—Parties having light machine shop and wood-working equipment, to manufacture a good specialty; customers waiting; requires $1,500 to build first machine; detail drawings furnished by patentee; royalty contract or option. Box 201, AMERICAN MACHINIST.

$100,000.00 is one of the prizes offered in the St. Louis World's Fair aeronautical contest. Being an engineer who has devoted over 10 years to this work, I am confident that my present design for a machine will have every chance of success. For speed, the bulky balloon affair will not be in it. A partner to do the machine-shop work is wanted. W. C. Smith, 22 Whittier ave., Amesbury, Mass.

Wanted—Factory Buildings.—A company now operating two separate plants, employing 300 hands (male), desires to consolidate its manufacturing into one plant within a convenient distance of New York, preferably within 30 miles; want a factory building or buildings, ready for occupancy, modern construction, with not less than 50,000 square feet floor space. Address, with full details, Box 191, AMERICAN MACHINIST.

For Sale.

For Sale—An interest in a well-established foundry business, paying well; satisfactory reasons for selling. Address F. B., care A. M.

Boring and Turning Mill.—Second-hand 8 ft. boring and turning mill for sale at a bargain. For particulars address Chase Engine & Manufacturing Co., Mattoon, Ill.

For Sale—Four complete sets of patterns with all drawings for large machine tools; will be pleased to correspond with parties wishing to take up a good line. Box 442, AMERICAN MACHINIST.

For sale on favorable terms, the following Bath grinders: 2 No. 2 Water without strengthening knee and tray, 5 No. 2 Water with strengthening knee and tray (our latest type) and 1 No. 1 Dry. Parties interested correspond with Loop-Lock Machine Company, Waltham, Mass.

For Sale—A machine shop in New York city (Manhattan); suitable for special machine building, automobile and general repair work. Established three years. Fully equipped with modern tools, all in first-class shape. Good location. Address R. C. Handloser, M. E., 127 Duane st., New York.

Business Opportunity.—A $15,000, well-equipped machine shop for sale; all new machinery; will sell to move to another city or will take in new capital to push the manufacture of the Dickinson gasoline engine, which is now on the market in Michigan. Address F. T. Dickinson, 153 West Main st., Battle Creek, Mich.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.;

foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

I have 25 volumes of the AMERICAN MACHINIST, from Vol. 2 to 26, for sale; Vols. 2, 3, 9, 11, 12, 13, 14, 15, 16, 17, 18 and 19 bound half roan black cloth; Vols. 4, 5, 6, 7, 8, 10, 20, 21, 22, 23, 24, 25 and 26 unbound; Vol. 26 has 10 missing numbers, rest complete; all indexes, except last three; well taken care of; a rare chance to get a file; price $85, buyer to pay freight. Address "File," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Mechanical engineer, technical graduate, 38 years, 15 years' experience, office work, drafting room, cost system and shop management, good organizer, desires position as superintendent or assistant. Box 196, A. M.

Fifteen years' experience designing tools for interchangeable manufacture, the finer the better, also well up on thread rolling machines and rolling mill work, cartridge and automatic hopper feed press work, desires position of responsibility either as designer or in shop management; broad experience, good education and unquestionable references; vicinity of New York or New England preferred. "Waterbury," care A. M.

DELAWARE.

Mechanical engineer, age 28, technical graduate, 5 years' experience as designing draftsman and in charge of drafting room, will accept immediate engagement in operating, sales or drafting department; not particular about location. Box 173, AM. MACH.

ENGLAND.

Advertiser desires correspondence with a firm requiring the services of a works manager or superintendent; is at present engaged as such with electrical works in England; served one firm 8½ years in America in similar position; used to piece work; well educated; age 34 years. Apply Box 147, AMERICAN MACHINIST.

MARYLAND.

Mechanical engineer and draftsman, now in Baltimore, age 35, member American Society of Mechanical Engineers, technical education, practical shop man with business experience, desires position in any part of the country. Address Box 202, AMER. MACH.

MASSACHUSETTS.

Mechanical draftsman wishes to change. Address Box 186, AMERICAN MACHINIST.

Wanted—Position of responsibility, by young man; 13 years' shop and drafting-room experience; up to date on appliances for turning out work rapidly; understands handling men. Box 536, AMER. MACHINIST.

NEW YORK.

Position in salesroom, by young man with shop experience. Box 171, AMER. MACHINIST.

Capable chief draftsman, designer; general experience. Box 176, AMERICAN MACHINIST.

Assistant draftsman, 21 years old; 5 years' practical marine shop experience. Box 188, AMERICAN MACHINIST.

Wanted—A position as mechanical draftsman, by a young man of experience. Address R. S., care AMERICAN MACHINIST.

Draftsman and designer in tools, jigs and general machinery; 23 years old; $60 monthly. Box 189, AMERICAN MACHINIST.

Draftsman, mechanical, graduate, 26 years of age, first-class man, is open for engagement. Box 200, AMERICAN MACHINIST.

A first-class toolmaker as foreman, being able to manage men, having 25 years' experience; best city references. Box 194, AM. M.

Ad. Writer—First-class man, experienced in machinery advertising, seeks position, at good salary, with responsible company; references A1. Box 133, AMERICAN MACHINIST.

Practical machinist; wide experience as foreman in handling machine shop, toolroom and manufacturing departments in sheet steel, brass, tin and hardware; good reference. Address F. G., care AMERICAN MACHINIST.

Works manager or superintendent, familiar with modern methods in machine shop, foundry and boiler shop, engines and general machine work; 6 years with large electrical company; thorough mechanical and business training; good executive ability. Box 175, AMERICAN MACHINIST.

OHIO.

Wanted—Position as superintendent or general foreman, by a thorough, practical mechanic, with 12 years' experience; age 38; member of A. S. M. E. Box 76, AM. MACH.

PENNSYLVANIA.

Working foreman patternmaker, experienced on gas engines. Box 190, AMER. MACHINIST.

Position as manager of machine shop or foundry; experienced in buying and selling as well as general office work and detail shop management with satisfactory cost system; have large acquaintance in all sections of the United States; age 37. Box 139, AM. M.

VERMONT.

Machinist; temperate; 7 years, job shop, steam engines, boilers, pumps, gas engines; South preferred; references. Address Box 197, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Wanted—Machine shop foreman, experienced on dies, forms, punches, jigs, fixtures and general repair work. Address, with references, age and experience, H. A., care AM. M.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and core-makers; we always have vacancies. Address Allis-Chalmers Co., New York Life Bldg., Chicago.

MASSACHUSETTS.

Wanted—Reliable draftsman to make working drawings; state experience. Crompton-Thayer Loom Co., Worcester, Mass.

Shafting-hanger salesman wanted; only men of experience in this line need apply; give references and experience. Address Box 132, AMERICAN MACHINIST.

Wanted—In New England States, an experienced mechanical draftsman; application should state age, education, experience and salary expected. Apply Box 179, AM. MACH.

Wanted—Wideawake foreman, capable of handling shop in Eastern Massachusetts, employing about 30 men, manufacturing special machines and doing considerable jobbing work. Box 193, AMERICAN MACHINIST.

MICHIGAN.

Wanted—First-class machinist to take charge of machine shop in large manufacturing plant; applicants state age, experience and references. Box 192, AMER. MACHINIST.

NEW YORK.

Wanted—Mechanical draftsmen, experienced in shop practice and designing special machinery; none others need apply; state experience; good positions for the right men. Address A-961, care AMERICAN MACHINIST.

OHIO.

Shop superintendent, with up-to-date methods in handling tools and men; one familiar with cost and apprentice systems; state age, experience; give reference and compensation expected. Address Box 198, AMER. MACH.

Wanted—Draftsman and designer on a general line of sheet, stamping and bar metal working machinery and tools; excellent opportunity; permanent position to right party; do not apply unless thoroughly competent. Box 180, AMERICAN MACHINIST.

PENNSYLVANIA.

Wanted—A man familiar with tool dressing and the hardening and tempering of steel tools. Box 199, AMER. MACHINIST.

Bright young man, familiar with bookkeeping and cost system in manufacturing concern; state age, experience and salary expected; an exceptional opportunity for the right man to form a permanent and desirable association. Address Box 177, AM. MACH.

Wanted at Once—A foundry foreman and a foreman for machine shop; both must have some capital and be up to date in their lines, able to handle men to best advantage and turn out work quickly and right; must be sober, reliable and hustlers; a splendid opportunity to the right men. Address R. F., care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wood worker for pattern, cabinet and some rough work, also metal worker for careful hand and machine work; some electrical and some rough work; at high-grade technical school; best of facilities and equipment. Box G, Golden, Colo.

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